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During the War, almost exceptionally among technical publications and periodicals of the character of the ELECTRICAL REVIEW, we have refrained from increasing the price. Owing, however, to the constant increases in cost of paper, printing, engraving and production charges generally, we have reluctantly decided that the price from the beginning of this year must be raised to 6d. per copy. The change will not apply to unexpired subscriptions.

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THE GERMANS AND INTERNATIONAL AGREEMENTS.

As far as facilities for obtaining information on the subject have been at their disposal, the big German electrical firms have been closely following the developments in the electrical industry in the West during the past few months. Amalgamations of works in England, the establishment of communities of interests between companies in the United States and France, the formation of closer connections between English and French and Belgian firms, and the affiliation of interests between English and Dutch companies—these and other questions have aroused keen interest in leading circles in Germany, whose ruthless methods of warfare caused the termination of the former connection between a prominent American company and one of the big Teutonic works. Not only so, but this particular connection has now been transferred to France, whilst a former Dutch relationship has also been lost by Germany in favour of England.

It almost seems as if the Germans are now asking, "Where do we come in?" Certainly they desire to come in. At the annual meeting of the A.E.G., late in December, Dr. Rathenau informed the shareholders that it was known that efforts were being put forth in the West to form large trusts, although the Germans, for the time being, were not in touch with the Western groups. The chairman added that "an opinion could not be formed as to whether a time would come when they would be able to co-operate with them"—the groups. Apart from somewhat vague reports which have been in circulation for some months past, the statement made by the chairman of the company in question, represents practically all the information conveyed officially from the works in that country concerning their wishes in relation to other countries. They neither reveal their plans for the home market nor disclose what they are seeking to obtain in other countries, although this reticence is perhaps only natural under the circumstances. As a consequence, it is necessary to rely either upon unofficial information or upon deductions from the course of events.

As far as the German inland market is concerned, the fact may be recalled that even in pre-war periods the big German firms occasionally co-operated with each other in the case of transactions involving very considerable sums; whilst in other respects they competed with each other, at all events outwardly, until the publication of the details of the secret price agreement existing between them finally dispelled any illusions which may have prevailed on the question down to that time. Apart from the separation years ago of two heavy electrical engineering works from their original owners and their transfer to an independent company, and the taking up by one company of a large financial interest in another, no actual community of interests by means of an interchange of shares, has yet been established in the German electrical industry. As has been

shown in other branches in that country, no incentive exists in a period of highly satisfactory trade for an interchange of shares or a consolidation of various financial interests. But the conditions of the world have undergone a change, and necessity may force the hands of those firms who have hitherto desired to retain their independence and compel them to join together for self preservation. In this connection, a German newspaper reveals what is projected. It is stated, for instance, that there is no doubt that a great German electrical trust will be formed, sooner or later, for the purpose of warding off "hostile attacks," and strengthening the economic power of the industry in the home market. The recent consolidation of the glow lamp manufacturing branch is a precursor of coming events, and it would scarcely be surprising if the electrical industry were transformed into a great combination on the lines of the aniline dye trust, which was considerably extended just two months ago.

If, then, it is correct to assume that the big firms intend to amalgamate in some form or other in the near future, the chief object in view will be to obtain sufficient strength to be able to present a united front in the case of competition in the markets of the world, in the event of its becoming impossible to conclude an understanding with groups of makers in other countries. As already shown, Dr. Rathenau was not very explicit at the recent meeting of the A.E.G. But the newspaper previously referred to is quite candid respecting the German intentions. It states that the plans entertained by the leading firms are first to complete the organisation of the home industry, and then to endeavour to form international agreements! If this effort should be successful, the newspaper remarks that an important service will be rendered to the national economy.

It is quite impossible to understand the mentality of the Germans in thinking of the bare possibility of being able to establish working agreements with Allied countries. The mere suggestion is an admission, if not of weakness, at least of apprehensions as to the future of the German electrical industry. Let, then, the apprehensions have full play, for surely no electrical group could possibly work in harmony with those who provoked the great war, deluged the world with blood, and caused the sacrifice of many millions of lives, but who were sufficiently cunning to keep the horrors of warfare outside their own frontiers, at least, in the West. The Germans wish by-gones to be by-gones, but this is totally impossible—the Allies cannot forget the terrible results of the five years of war.

The Electricity Supply Act.

From the King's Speech at the opening of Parliament on Tuesday, we learn that the clauses authorising the formation of District Electricity Boards, and providing for the compulsory purchase of power stations and main transmission lines, which were dropped from the Electricity (Supply) Bill last session, are to be reintroduced, and will doubtless be backed by the full weight of the Government. The House of Commons has already passed these clauses, but the opponents—practically confined to the company interests—may safely be assumed to have improved the opportunity to develop their case against the Government proposals, and we may look for a lively contest in the Commons as well as in the Lords. We should have thought it preferable to appoint the Commissioners, and give them time to study the situation in the light of their existing powers, besides affording an opportunity to supply undertakers to take stock of their position, and to enter into co-operative schemes on the freest possible basis. But even now we have not learnt the names of the new Commissioners, though we have reason to believe that some of them have been appointed.

We are at a loss to understand the reason for the delay. Is it that it is so difficult to find first-class men equipped with "practical, commercial, and scientific knowledge, and wide business experience, including that of electrical supply"? Or is it that such men are reluctant to divest themselves of all shares or other interest in supply undertakings? Or, again, is the Ministry unable to afford the market value of the men who possess the proper qualifications? The Ministerial actions so far have not presented any indication of "railway" speed; indeed, they resemble nothing so much as those of a "Government department."

[Whilst going to press we have acquired some later information on this subject. See our "Notes" pages.]

Returning to the promised Bill, the principal subject of contention will be the "standard price" clause; but whether the companies have much to gain by prolonging the agony is open to question. That they have just cause for complaint is undeniable; as pioneers many of them have borne the burden and heat of the day, without extracting much profit from the business, and they were hoping to reap a well-earned harvest during the last few years of their existence—assuming, of course, as one must, that their ultimate fate would be purchase by local authorities, as contemplated by the earlier Acts. They are undoubtedly entitled to some recompense for their efforts. On the other hand, during the declining years of their concessions, they would have been unable to raise capital, and indisposed to spend it (the latter days of the National Telephone Co. present a close parallel), and the public interests would unquestionably have suffered detriment from this cause, to avoid which, in many cases, the undertakings would probably have been purchased some years before the appointed day, at a higher price than their ultimate value.

The new Bill will render them liable to purchase—and compulsory purchase—at a still earlier date, and, consequently, the price ought in equity to be still higher also. That is what they have a right to expect under the terms settled by Parliament in 1888, and acted upon ever since.

In point of fact, however, they are offered for their power stations and mains the capital expended less depreciation—practically the "then value" that would have obtained if the war had not intervened, but less than half the present value under the actual conditions. No one, however biased, can pretend that this is fair. On the other hand, if they elect to dispose of the whole of their undertakings, including the distribution systems, as they are entitled to do under the Bill, to the District Boards, they will receive the whole of their expended capital without deduction for depreciation. This, while taking no account of goodwill, and to that extent unfair, at any rate constitutes a closer approximation to justice, the return being more than the price that would have been payable if the war had not happened, but less than the present value of the plant. It is up to the representatives of the company interests to endeavour to secure an improvement on these terms, and for that purpose to adopt more efficient tactics than those which permitted the Government to "do them in the eye" last session.

Whether it is worth the while of the companies to try to defer the day of purchase is a debatable question. On Joint Electricity Authorities and District Boards alike, their representatives will almost invariably be heavily outvoted, and it is a regrettable fact that municipal authorities, though less bitter towards companies than formerly, are still unwilling, with some exceptions, to co-operate with them cordially; indeed, in a few areas their attitude is frankly hostile. Under these conditions, the companies may naturally conclude that life is not worth living, and prefer to take what they can get for their undertakings and clear out of the business. In that event we may, in a few years, see the whole of the electricity supply of this country concentrated in the hands of a small number of communal public bodies. The alternative is to remain in the business and place their valuable experience at the service of the joint authorities.

Decentralisation of the I.E.E.

An amusing feature of the dinner of the North-western Centre of the Institution last week was the friendly skirmish between the rival camps of London and Manchester. While the "London Centre" (as Manchester regards it) is in possession of headquarters, the N.W. Centre considers itself every bit as good, and a bit better. "Facts is stubborn things," and the nine points held by London are not easily disposed of; but the North-West clearly means

to secure a fair share in the government of the Institution, and has already a series of notable successes to its credit. As the President pointed out, the history and traditions of the Institution are rooted in London, but years ago the Northern Society of Electrical Engineers—the only rival society that the Institution has known in this country—was a strong and flourishing body, and although it was united with the larger society, it had—and in the person of the N.W. Centre, it has—traditions of its own; it looks upon London rather as an elder brother than as a parent, and, though it is sincerely loyal to the President and Council, it is determined to uphold its right to a due share of responsibility and trust in connection with the Institution's affairs, especially those which more particularly concern itself. The special points mentioned by Mr. Robertson were the desirability of printing some, at least, of the Students' papers in a Students' *Journal*, the necessity of relaxing the regulations for the admission of candidates in order to prevent the exclusion of worthy men whose war service had interfered with their professional careers, and the claim of the Centre to deal with local applications for membership.

Mr. Wordingham's suggestion that the chairman and vice-chairman of the new Liverpool Sub-centre should be on the Committee of the Centre, just as the chairman and past-chairman of the Centre sit on the Council, calls to mind his remark at a recent meeting that the multiplication of new Centres was impossible, because the chairmen and past-chairmen would swamp the elected members on the Council. This argument seems a rather leaky one. Why should they not? An elected member may be chosen by a comparatively small portion of the electorate, but the chairmen and past-chairmen are chosen as the trusted representatives of the Territorial Centres, and it would be just as reasonable to maintain that the latter should not be outvoted by the former. A much more plausible objection to the development of this system of creating a Council is that the business of the Institution makes heavy demands upon the Members of Council who are in a position to perform the duties, and that it is not feasible for provincial members to put in the necessary time at headquarters.

Enemy Debts. The appointment of a Controller for the collection of pre-war debts between ourselves and Germany, again raises the dissatisfaction on the part of British traders in regard to this matter, and a more serious attempt is now to be made to bring the views of the business community before the authorities. Under the Economic Clauses of the Peace Treaty, which, on the whole, do not appear to have received the consideration at the hands of the general public which they deserve, all debts owing to Germany by us, and all debts owed by Germany to us, are to be paid through the Clearing Houses which, under these clauses, are now established in London and Berlin. To that, of course, there is no objection. The main cause of the grievance which is now being ventilated is the condition that debts on both sides are to bear interest at the rate of 5 per cent. per annum from the commencement of the war. Whatever the considerations were which impelled the Government, through its commercial advisers, to agree to this condition, it is perfectly clear that there will be many hard cases in this country. Take, for instance, the case of a firm owing a considerable sum to Germany, for which a cheque was sent a day or two before the declaration of war, which cheque when presented was, promptly and rightly, refused payment by the bank here. There are many such firms, and their point of view is that it is a great injustice to them to be made to increase their payment to their German creditors by an amount equal to 5 per cent. per annum for five years. In such a case as we have mentioned, this is the position as it is put forward, and there seems sound reason in it. In the first place, the firm was willing and able to pay the net amount of the debt in 1914. Acting prudently, it would seek to invest the money in some easily realisable stock in order to be able to pay it over when the time came. In 1914, the only stock of that character would be the 3½ per cent. War Loan. In any case, it is extremely unlikely that an average of 5 per cent. will have been earned on the money, and the firm has, therefore, not only to suffer the penalty of making up the difference, but also to bear the loss of the depreciation in the capital value of the stock on sale at present prices. There are many such instances; and now that the clearing houses are in existence, and the Controller is demanding the debts which are owed to Germany "forthwith"—and, with a delightful sense of humour, adding that no guarantee can be given when the debts owing from Germany will be paid—British business men concerned are putting their heads together to consider the best means for meeting the situation. It is not suggested that the Peace Treaty can be modified, but the point is seriously being put forward that, in the absence of any discretionary powers on the part of the Controller, the Treasury should be asked to bear the losses which the Government has, it is felt, gratuitously placed upon the shoulders of the trading community. We doubt very much whether any success in that direction will be achieved, and, in the present state of the national finances, we cannot view lightly the prospect of a large sum having to be found for this purpose; nevertheless, the grievance is a real one, unless there is a countervailing advantage on the other side, which we have not yet heard of. From dealings which have taken place between the Controller and British debtors to Germany, there is a belief that he has some discretion to deal with the difficulties which are inevitable, but whether this discretion covers the main cause of complaint is not yet clear. Another grievance is that the clearing-house system, which compels payment in either direction, only applies to Germans resident in Germany There are, however, a large number of pre-war debts owing by Germans resident in other parts of the world which it may be extremely difficult to collect now, and it is felt that some Government action should be taken in this matter.

The D.O.T. In our opinion, the Department of Overseas Trade has an excellent opportunity for gaining the confidence of British manufacturers and traders. Like most of our organisations, it has been passing through a period of transformation and reconstruction during the past year, and there are indications that its new or altered machinery is getting to work satisfactorily. It is for the Treasury to see that so necessary a Department does not suffer for want of means. If it is folly for a private firm to attempt, with insufficient funds, to build up a big export business which shall be permanent and shall afford a profitable outlet for the enormously increased production that will come sooner or later, it is something worse for a national effort intended to facilitate such operations for the good of the whole community to be handicapped by want of the vital wherewithal. However efficient may be the organisations established for foreign trade promotion by manufacturers who operate through trade associations—and they are unquestionably doing good work—there is a place for the Government to fill on behalf of all, both associated and unassociated. We believe that the D.O.T. is now alive to the greatness of its opportunity, and in co-operation with the Trade Press it should, if it pursue an enterprising policy, can work with freedom, can escape the soothing influences of official existence, and continue ever wide-awake, gain the esteem and gratitude of both traders at home and purchasers abroad. One of the Department's present developments is in the hands of its Economic and Editorial Section, which is preparing a series of Manuals, or Handbooks, of Commercial Information relating to each of the principal foreign countries, in which will be published basic information which will be of assistance to merchant-bankers, traders, and others interested in trading operations. Manuals for France and the Argentine are now in an advanced stage of preparation, and some material has been accumulated for similar publications on Brazil, Italy, and Greece. Annual reports will also be issued, taking the place of the Consular reports to which we were accustomed in pre-war days. These will appear more promptly, and, no doubt, will be far more serviceable to the trading community.

ELECTRIC SUPPLY AT THE LONGBRIDGE WORKS OF THE AUSTIN MOTOR CO., NORTHFIELD, NEAR BIRMINGHAM.

THE Austin Motor Co.'s works, being situated outside the distribution area of any large undertaking, have generated their own electric power from the commencement, and the history of the system has been like that of many others, in that many changes have taken place in the process of keeping up to date.

The first system was direct current at 110 volts, with small gas and steam engines as prime movers. The works increased, and the advantages of three-phase alternating-current motors were appreciated, so in 1914 it came about that a new power house was built on a more suitable site to contain a larger plant, comprising six 175-KVA. alternators by the Allmänna Svenska Elektriska Co., with exciters direct coupled, driven through flexible couplings by high-speed engines at 375 R.P.M.

The alternators generated three-phase current at 525 volts, 25 cycles. Two were driven by gas engines, the remainder by Belliss & Morcom compound V-type two-crank enclosed steam engines. Exhaust steam was led into a common main connected to a Ledward & Beckett ejector condenser. Rapid increase of load due to the manufacture of muntions of war, in which the firm took so prominent a part, necessitated a corresponding increase in the generating capacity, and two 1,250-KVA. 1,500-R.P.M. vertical Curtis turbo-alternators by the B.T.H. Co. were installed in 1915. The sub-base surface condensers of these were supplied with cooling water from a Crichton wooden cooling tower erected on an adjacent site, make-up water being obtained from the brook which flows through the works. Each condenser was served by a motor-driven circulating pump, and a motor-driven Edwards three-throw air pump at 75 R.P.M. The boiler house then contained eight 30 ft. × 9 ft. 6 in. Lancashire boilers, six by Yates and Thom, one by Edwin Danks, and one by John Thompson, all equipped with Units superheaters, two Green economisers, and a natural-draught brick stack of 7 ft. internal diameter, 170 ft. high. Steam was supplied at 160 lb. pressure through a 12-in. main to the engine room. Coal, delivered by rail, was conveyed overhead to the Hodgkinson mechanical stoker hoppers, from storage on the ground level. Standard vertical Weir feed pumps, of 5,000 G.P.H. each, supplied the feed-water through duplicate ranges. At times the demand for power was so great that the whole plant was in commission and carrying overload.

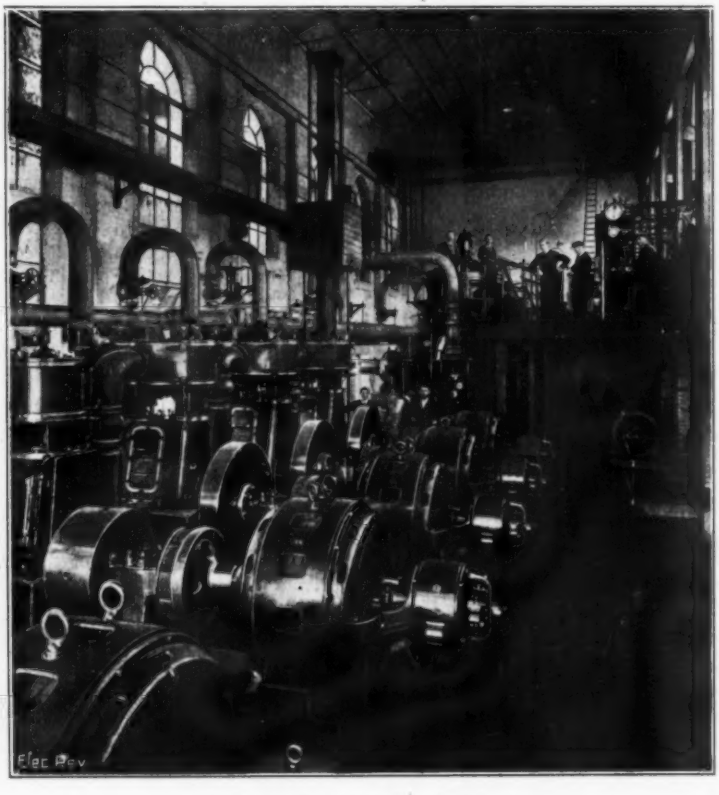


FIG. 1.—SOUTH POWER HOUSE.

During 1916 the company undertook and carried out the erection of two large new works on the opposite side of the railway, one known as the North Works, for the manufacture of 8-in. H.E. shell, from billets to the finished article, and the other, the West Works, for 18-pounder H.E. shell. The North Works, in use by the end of 1916, comprised a lay-out of power house, boiler house, hydraulic press house, with eight large presses, stamps, heat treatment furnaces, air compressor and hydraulic pump house, and a machine shop 900 ft. long × 300 ft. wide. To supply the new works, the most modern power plant was installed, viz. :—Three three-phase, 50-cycle, 550-volt, 1,850-K.V.A., B.T.H. horizontal Curtis six-stage impulse turbo-alternators at 3,000 R.P.M., with exciters direct coupled on the same shaft. Each turbine exhausts into a surface condenser, by Mirrlees, Watson & Co., in the basement. The condensate is extracted by a centrifugal Leblanc air-pump, and air is taken by multijector exhausters, of which there are two to each condenser, so that one can always be stopped to clear the nozzle in case of need, while the other is working. Electric motors of 70 H.P. each drive the circulating pumps for the cooling water obtained from three Crichton cooling towers 70 ft. high with a base area of 77 × 30 ft. Air, after passing through a Heenan and Froude filter, is drawn through the generators and discharged outside the turbine room. A 14-KW. D.C. Belliss-Crompton set is available to supply the emergency lighting at 110 volts. The current generated at 550 volts is supplied to the bus-bars at that pressure, and 24 feeders (20 37/12 and four 19/14), of three single cables each, supply the North and West Works. The main switchboard contains 12 double-feeder panels for 500 amperes each feeder, three generator panels of 3,000 amperes each, one instrument panel for volt-recorder and leakage ammeter, one 3,000-ampere panel to connect up three E.H.T. single-phase transformers now supplying current to the South Works, and three panels for the frequency changer, which converts from 50 cycles to 25 cycles for the South Works. The switchboard, of black enamelled slate mounted on steel-tube framework, extends nearly the whole length of the turbine room on the floor level, and has the standard B.T.H. equipment with oil-immersed switches, hand-operated from the front of the board. Three Tirrill regulators control the three generators.

During 1917 and 1918 the West Works were supplied through two banks of three single-phase Berry oil-cooled transformers of 625 KVA. each, by the British Electric Transformer Co., at 6,600 volts; but since the Peace requirements are only a small fraction of the former, the three step-down transformers have been removed to the South Works, enabling a large proportion of the 25-cycle plant to be replaced by the 50-cycle, which is now adopted as the standard. The West Works, now largely saw-mills and car-body shop, with paint-spraying and finishing departments, is supplied direct at 550 volts through two 3-core 0·125-sq. in. and one 3-core 0·3-sq. in. feeders, about

500 yards long. The boiler house contains 12 Lancashire boilers, 30 ft. × 9 ft. 6 in., by Yates and Thom, with Units superheaters, three Green economisers of 360 tubes each, a natural-draught brick stack of 9-ft. internal diameter and 200 ft. high, and an induced-draught fan driven by a 50-H.P. motor, with separate steel stack. There are four Weir vertical feed-pumps of 5,000 gallons per hour each, with a feed-heater in the pump house and a CO_2 recorder; steam is supplied at 170 lb. per sq. in. pressure through a 12-in. steam main to the turbine room. The steam temperature at the turbine stop-valve averages 550° F., and the vacuum varies from 28·5 to 29·5 in.: coal is delivered by rail, and the trucks are discharged by a tippler feeding the boot of an elevator and conveyor system to the boilers.

Since the Armistice, the company has performed the modern equivalent process of beating the sword into the pruning hook, the North Works now being a complete tractor factory, with its output commenced. The South Works, comprising large machine shops, erecting shop, hardening shop, stamp shop, inspection and experimental departments, &c., are engaged on the output of the 20-H.P. motor-car. In addition to this, aeroplanes, and petrol-electric generating sets, with storage batteries and automatic control requiring no skilled attention, for small installations suitable for supplying villages, institutions, and private houses, are being manufactured. The amount of power required at present is less than half that absorbed during the heavy periods of the War, so that the new power house in the North Works can cope with the whole supply, and the 25-cycle system has been converted to 50 cycles, with the exception of those motors which it is not convenient to replace yet. These are supplied through a frequency changer in the North Power House consisting of three B.T.H. machines, viz., a synchronous 815-KVA. motor, 550-volt, 50-cycle, three-phase, direct coupled to a 650-KVA., 25-cycle, 525-volt, three-phase generator, and a 19-KW., 80-volt, D.C. exciter, all mounted on one bedplate. There are over 500 motors installed, varying in capacity from 200 H.P., driving a hydraulic pump, to ½ H.P., rotating

Fig. 4.—North Works Boiler House.

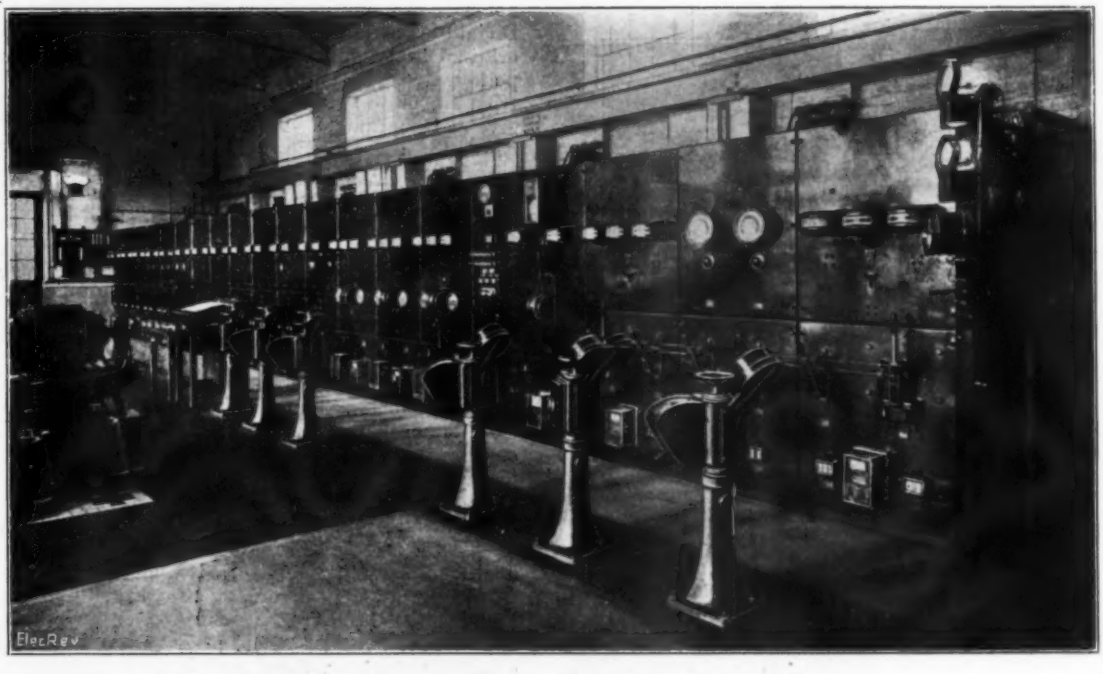


Fig. 2.—Main Switchboard, North Works Power House.

Fig. 3.—Turbo-Alternators in North Works Power House.

the air filter for the generators in the power house. There are a large number of 100-H.P., and 50-H.P. motors driving line shafting in the machine shops; the motors are of the induction type, mostly squirrel-cage, running at 720 R.P.M., with a few at 1,440 or 960 R.P.M. Speed changes are effected by means of pulley cones at the machines. Crane motors are of the slip-ring type, with grid resistances.

The South Power House now contains the three step-down transformers formerly in the West Works. The transmission from the North Works is at 6,600 volts, by two Pirelli-General Electric 3-core, 0·25-sq. in. paper-insulated, lead-covered, armoured cables, buried direct, except where carried over the railway on the outside of the girder bridge which connects the two works. The new 50-cycle switchboard in the South Works is the standard B.T.H. type, with one 3,000-ampere transformer panel, seven double feeder 300-ampere panels, and one single-feeder panel. The E.H.T. switches at both ends of the transmission are of the removable truck type.

Of great use in the works are 17 Edison accumulator battery trucks, 5 of 50 cwt., 11 of 40 cwt., and one of 30 cwt. capacity. Motor-generator sets are installed for charging these daily. The lighting is at 110 volts. Single-phase circuits are run between each phase of the transformer secondaries and the neutral point. In the South Works there are six, in the North Works four, and

Fig. 5.—Frequency Changer.

in the West Works three lighting transformers, oil-cooled, 90-K.V.A. primary delta 550 volts to secondary star 110 volts between phase and neutral, by the British Electric Transformer Co. The lighting is mainly effected by 300-watt and 200-watt lamps at half a watt per candle-power; smaller lighting is done by 20, 30 and 60-watt metal-filament lamps. Electric drills, desk fans, and printing arcs are run from the 110-volt circuits. About 150 clocks on the Synchronome system synchronise the works for time, and an electrically-controlled steam whistle, known as "The Bull," announces the times to start and cease work. Heating throughout the factory is effected by high-pressure steam at 100 lb. per sq. in., partly supplied from the power boilers, through reducing valves, and partly from an auxiliary boiler house containing six Lancashire boilers, two of which are fitted with destructor furnaces for consuming waste timber and other refuse. One Lancashire boiler has been transferred from the South to the West Works to supply the heating steam, and consumes wood refuse from the saw mills.

The works engineer is Mr. T. W. Hartley, and his chief assistant Mr. W. N. Y. King.

The Profiteering Act.—The Electric Lamps Sub-Committee of the Committee on Trusts has held its seventh meeting and considered its draft report.

THE FUEL OF THE FUTURE AND THE GAS COMPANIES.

By B. L. KLEMENS.

On two recent occasions the *Gas Journal* has been deeply stirred by articles under the above heading in the Electrical Review. On neither occasion has it been able to restrain its anger, and on both it indulges in abuse which has no effect on the case set out, apparently considering it high treason to ask for proof of Sir Dugald Clerk's statements, while to disprove them is an unspeakable crime.

The *Gas Journal*, apparently, can only see the mote in its neighbour's eye, and not the beam in its own, for while complaining that the Electrical Review occupies three columns in setting forth its points, it uses one and a half columns in attempting to dispose of a case which it describes as not worth disposing of. When the Gas Light & Coke Co. replied to a question concerning the amount of coke obtained by baking one ton of coal, that 8 cwt. are obtained, the *Gas Journal* says the words "for sale" should have been inserted after the word "obtained," because (so the *Journal* says) the gas company gave a net figure. But the statement does not bear examination. The coke sold, according to Sir Dugald Clerk, is equivalent to 41 per cent. of the original heat value of the coal; but the South Metropolitan Gas Co. says that the heat value of the coke is from 10,000 to 11,000 B.TH.U. per lb. (but it would not give any guarantee). The Gas Light & Coke Co., when discussing the efficiency of coke "boilers," gives the heat value as 12,000 B.TH.U., and when it tries to support the 70 per cent. or 80 per cent. advertisement, as 12,350 B.TH.U. per lb. The *Gas Journal* says that it is 12,500 B.TH.U. per lb. It is clearly impossible for all these different values to be equal to 41 per cent. of the coal heat value with the same amount of coke. If 20 lb. of coal yield a net 8 lb. of coke having a heat value of 41 per cent. of the original coal heat value, then, at 13,000 B.TH.U. per lb. for coal, 8 lb. of coke are equivalent to 106,600 B.TH.U. = 13,325 B.TH.U. per lb. That is, the coke has a higher calorific value than the coal, which is absurd. The *Gas Journal* also suggests that the efficiencies used for calculating the mean efficiency of gas for cooking purposes, are not those of the latest type of apparatus. This, however, is not at all probable, for all the efficiencies were those quoted by the Gas Light & Coke Co. except for that of the oven, for which, as its figure was palpably false, Sir Dugald's figures were taken. Can anyone imagine the Gas Light & Coke Co., or any other gas company giving particulars of anything but the most efficient apparatus, when replying to a correspondent who wished to know the amount of gas required to perform certain operations? It was quite clearly stated in my article that the boiler efficiency was assumed at 50 per cent. Instead of producing nearly two columns of rhodomontade on the second occasion, the *Journal* would have been better employed explaining by what scientific means Sir Dugald Clerk makes the watt-hour the equivalent of more than 3.412 B.TH.U. He states that the one-watt lamp requires the use of 54 B.TH.U. at a generating station, per candle-hour, with an efficiency of 8.5 per cent. at the lamp. That is, the watt-hour, according to him, is equivalent to 4.590 B.TH.U., when he seeks to compare quantities of heat used; an error of nearly 35 per cent.

The first actual criticism refers to the efficiency of the gas-making process. The *Journal* denies that Sir Dugald said anything about entirely converting the coal into gas without coke or tar residue, and then proceeds to quote him as saying: "If we consider the whole of the heat used in the process (amounting to 29 per cent.) to be debited against the principal product—coal gas—then to obtain 25 heat units in the form of gas it is necessary to use a total of 25+29=54 heat units of the original coal." The *Gas Journal*

needs to refresh its memory, or else it has deliberately refrained from quoting the next sentence, which, although Sir Dugald wisely refrained from putting this theory into words, entirely disproves the *Journal's* contention. The sentence in question is: "That is, the thermal efficiency of the gas-making process is 25/54 equals 0.46, or 46 per cent." On the figures originally given in the lecture, coal equivalent to 54 heat units would be converted into gas equivalent to 13.5 heat units, and coke and tar equivalent to 24, but if the *Journal's* assumption is correct, the gas yield is doubled, and coke and tar remain also. As stated in the Review, such figures are fantastic and absurd, because coal cannot be treated on this basis, but even if it were possible, it has nothing to do with the point at issue, which is, that when Sir Dugald gives 3.4 heat units as those usefully employed in the oven for every 100 at the gas works, he is assuming (whether rightly or wrongly is immaterial in this particular case) that 46 heat units are delivered to the oven out of this 100, and the efficiency of the oven was therefore only half that assumed in the first article.

If, for the sake of argument, the Gas Co.'s wholly erroneous statements concerning the coke were accepted at their face value, it would still be necessary to convert a net 34,800,000 B.TH.U. (making full allowance for coke and tar) to do by gas the work that can be done by electricity for a destruction of coal equivalent to 16,400,000 B.TH.U. This, of course, is only a paper comparison, for 58,240,000 B.TH.U. must be converted by the gas companies, and the net figure would only be true if the coke and tar heat values could be used at cent. per cent. efficiency. Even assuming that this impossible supposition were true, our coal supply would be exhausted twice as fast if gas were used as the medium for lighting and heating, instead of electricity.

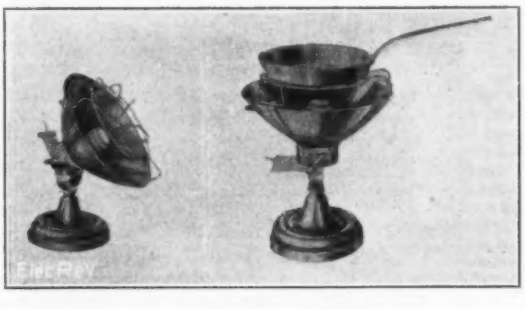
THE IDEAL HOME EXHIBITION.

When, on the afternoon of Wednesday, February 4th, H.R.H. Princess Alice, Countess of Athlone, opened the *Daily Mail* Ideal Home Exhibition at Olympia, there were on view some 250 displays, each devoted to the comfort, convenience, and cheap running of the home. In addition, there are sections dealing with the garden, poultry rearing, labour-saving appliances, music, recreation, and baby-land. In the annexe the Ministry of Health has erected a miniature village of ideal homes for workers, and also a panorama of the city of the future, while the Ministry of Agriculture is responsible for a full-sized allotment which has vegetables growing as in June. The great question of the day, housing, is thoroughly illustrated by many types of structures in a variety of materials; a housing conference, organised by the Royal Institute of British Architects, was begun on the opening day, while kinematograph displays and popular lectures will be given at frequent intervals during the period the exhibition remains open until February 25th. The exhibition and the conferences, organised with the cordial help of the Ministries of Health and Agriculture, the Royal Institute of British Architects, the Architectural and the Garden Cities Associations, and others, should prove of much utility; the public will see what can be done by a wise expenditure of money to overcome difficulties, and the labour-saving section especially should appeal to all.

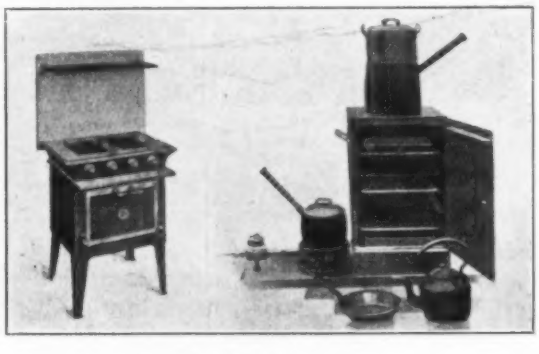
There has never been anything quite like the present exhibition; it is one that nobody can afford to miss seeing. Many things of utility, adornment, comfort, economy, and labour saving that contribute to the conception of the ideal home are on view, and various phases of house construction and equipment can be studied at first hand. It is easy to recognise that the difficulty of maintaining an adequate domestic service lies at the root of the problem of the home lover to-day. Ingenuity is being exercised to reduce manual labour in the home to a minimum, and electricity is being called in to discharge the thousand and one tasks which in the past have made housekeeping a burden. Electricity in the home comes into its own at this exhibition; the ideal home, heated, lighted, cleaned, and kept comfortable by the aid of electricity, which cooks, washes up, and in many other ways acts as handmaiden to the house-wife, is thus realised.

Many of the electrical exhibits are not new, they were on view at other recent exhibitions; nevertheless, a feature of this exhibition is the fine and complete display of modern labour-saving devices, and a striking concentration of electrical household appliances is that given by the "all electric" house which is, in fact, an exhibit in itself well worthy of a special visit. The idea of a stand in this form, not only equipped with electrical devices throughout, but showing each in its proper position and at work, is excellent, and one that must appeal directly to the public.

The *Daily Mail* announces its intention of sending every member of its staff throughout the country to the Exhibition at its own expense. This excellent idea could, with advantage, be emulated by the electricity supply undertakings, as there is plenty to be seen, not only of an educational character, but also calculated to inspire confidence and to suggest the vast influence which electrical methods may have upon the art of home building. We might point out that any difficulty in the payment of expenses might be overcome, under Clause 30 of the Electricity (Supply) Act, by the Electrical Development Association arranging a conference or meeting at the Exhibition. Any electricity undertaking is empowered under this clause to pay the expenses of any delegates or members of its staff nominated to attend such conferences.



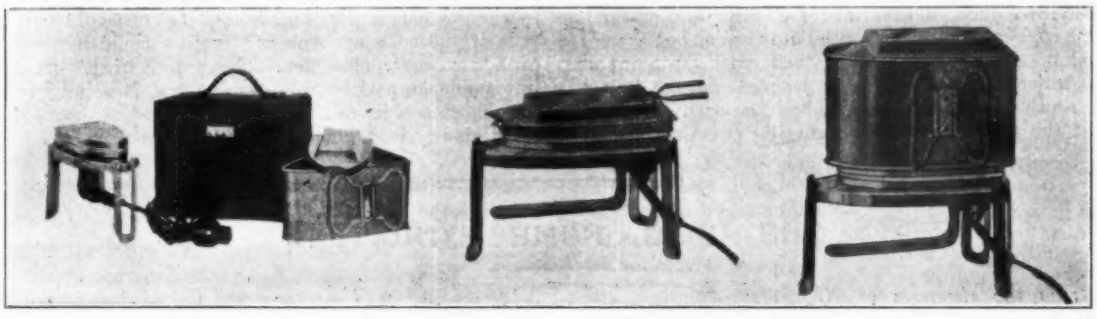
Figs. 1 & 2.—Pedestal Heater and Cooker.



Figs. 3 & 4.—Domestic Cookers.

The General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C. 4.—This exhibit takes the form of a two-storey model house, completely equipped with electric lighting, heating, cooking, and other appliances, and is proving a great attraction. On the ground floor of this "all electric" house the kitchen,

larder, living room, and parlour are situated; these are connected with the wash-house and store by an artistically-constructed pergola. The first floor contains three bedrooms and the bathroom. In all the rooms and on the landings the lighting arrangements are well thought out, fittings suitable for every part of the house being available. Each room has its electric radiator, of a design in keeping with the decorative scheme. Radiators can now be obtained with a switch to enable a graduated heat control to be obtained; some will permit of the boiling of a kettle, and a noteworthy one, the "Magnet" (figs. 1 and 2) pedestal heater, placed in the living room, is instantly adaptable for toasting, boiling, frying, and stewing—a pleasing combination heater and cooker, the utility of which does not spoil its attractive appearance.



Figs. 5, 6, and 7.—Electric Iron and Travelling Outfit.

In electric light in the home we have a steady source of illumination that is completely isolated from the surrounding atmosphere, thus avoiding all the fumes that are bound to arise when light is produced by combustion. During the last few years advances have been made in this branch of electrical science, and in innumerable ways electric light has proved a blessing. It is switched on instantaneously from any selected position, and in reply to the objection that has sometimes been raised that electric light cannot be "turned down," a type of switch is now been made that enables a lamp to be lowered as required, instead of being switched off entirely. The quality of the light given by the best makes of lamp is so well known that it seems almost superfluous to emphasise it; it is soft and pleasant to the eyes, especially good when much reading and study has to be done.

Fig. 8.—Electric Washer.

Towards the kitchen, of course, and its operations, the eyes of the housewife will be most frequently directed. Here we find that electricity is the ever-willing servant. The electric cooking range (fig. 3) is an ideal which most women will strive for; it is clean, makes no dust or smoke, and produces no fumes. Smaller pieces of cooking apparatus, fig. 4, grillers and toasters, will prepare a meal in a few minutes; there is no bother of fire-laying, no lengthy wait for the stove, or oven, to "warm up." Accessory appliances, such as warming-plates, hot-plates, food warmers, are shown; these, of course, are just as useful in the living-room as in the kitchen, for a great part of the charm of electricity is the cleanliness which allows of the preparation of a meal in the room where that meal is to be consumed, if it is so desired. The universal voltage electric iron shown in fig. 5 comprises an iron and stand, with curling tongs heater and boiler, all packed in a neat leatherette case. The reversed iron on its special stand becomes the hot plate on which the other utensils are heated. Fig. 6 shows how by fitting the lid of the boiler it becomes a curling tongs heater, and fig. 7 shows the boiler in position for heating small quantities of water.

A dish-washer, driven and heated by electricity, is a feature that all housewives will covet; and polishing apparatus will save much labour when cleaning silver, cutlery, &c

The wash-house contains an application of electricity that will perhaps save more labour and annoyance than any other—a washing machine, fig. 8, easy to operate and speedy in action. By its use the terrors of "washing day" can be disregarded; and the wringing, by a simple accessory, is done by the machine at the same time. After washing, comes drying—where the electric fan may help—and ironing. The electrically-heated "Magnet" iron is a boon; it saves all the delay of waiting for the heating of the ordinary solid iron, for it is ready for use in a few minutes after the switching-on of the current.

Turning to the living room, we find the invaluable toaster, which toasts quickly and deliciously. Electric kettles are available at a moment's notice; these, naturally, are shown in several of the rooms, as are the useful hot-plates, which will either prepare food and boil water, or, in the case of warming-plates, keep them hot until required.

In the parlour, as in the entrance hall, we find a cigar-lighter, which will also light a pipe, where electricity plays the part of the burning match. An electrically-driven sewing machine will delight the heart of the home worker. And when the parlour is only needed for an hour or two, nothing is more easy than to switch on the electric radiator—with no after-results in the way of ashes and dust.

Upstairs, the house is attractively fitted with many appliances which continue to prove the well-nigh universal possibilities of electrical energy. The bedrooms, of course, have their electric fires and pedestal heaters, so that the lighter forms of cooking can be done

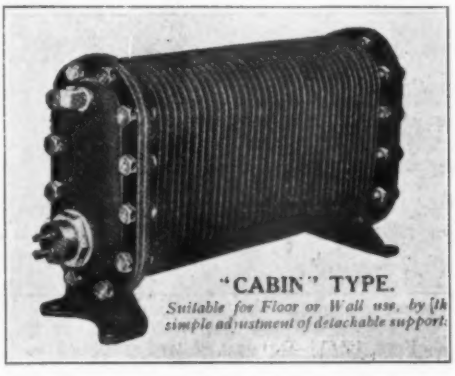


Fig. 9.—Electric Hot Water Radiator.

if desired—extremely handy in the event of illness. A milk warmer explains its own use by its name—the household with a nursery will appreciate this; the toilet-table has its electrically-heated curling-tongs, and the electric shaving-mug is a device that will appeal to the masculine mind—it solves the shaving-water problem completely, bringing precisely the right quantity of water to the correct temperature in two or three minutes. Most of these smaller articles, including the pedestal heater, can be run from the ordinary lighting plug.

For the cleaning of the house an electric vacuum cleaner will do the work of a couple of maids, and by its use the broom and dustpan can be eliminated.

In the bathroom we find an electric towel-rail and gown-rail, capital items for drying and airing towels, linen articles, costumes, &c. Hot water for the bath and lavatory basin is supplied at any hour of the day or night by an electric calorifier, situated in the scullery; it can be placed, however, where it is most convenient, and it is automatic, regulating its own heat.

Besides the "Magnet" electric fires there is another type of heater, known as the "Magnet" electric hot-water radiator (fig. 9), which does not give a radiant heat as is the case with fires, but effects a uniform heating of the surrounding air by means of the convection currents set up. For this purpose they are economical heaters giving a high efficiency with a low energy consumption, and at the same time the fire risk is practically nil. They are made in two types, the "column" type and the "cabin" type. The former comprises a system of tubular hot water circulators provided with a large number of heat distributing gills or blades. A dual pattern immersion heater is fitted at the bottom, so that a varying heat control can be obtained. The "cabin" type is of similar construction, but is broader but not so tall, a single heat-immersion heater being provided. These radiators need no attention except that it may be necessary once a year to add a little water through the water filler. The construction is particularly robust being entirely of steel and brass.

But it is impossible to mention in detail everything electrical provided by the enterprise of this company in its original exhibit, which must be seen to be fully appreciated. It is a revelation of the manner in which, of recent years, electricity has proved to be an ever-ready servant, making the work that remains a pleasure. The house, we should add, has been specially designed by Mr. Albert J. Thomas, L.R.I.B.A., and constructed by Messrs. Humphries, Ltd., the furnishing is by Messrs. Harrods, Ltd., the sanitary fittings are supplied by Messrs. J. Bolding & Sons, the tiles by Messrs. Geo. Tucket & Co, and Messrs. Roberts, Adlard and Co.

Messrs. Strode & Co., Ltd., 48, Osnaburgh Street, London, N.W. 1, exhibit country house lighting plant consisting of a horizontal low-speed oil engine burning cheap paraffin, and controlled by a governor which ensures steadiness in running and economy in fuel consumption. Constant attention or regulation is unnecessary; the plant is simple in character and easy to manage. Where space has to be economised, a low-speed dynamo is direct-coupled to the engine, but, where sufficient room is available, a belt-drive can be supplied. All working parts of the dynamo are easy of access for inspection and cleaning, and, at the same time, well protected against accidental contact. The generating plant requires to be run three or four hours per day to charge a battery of

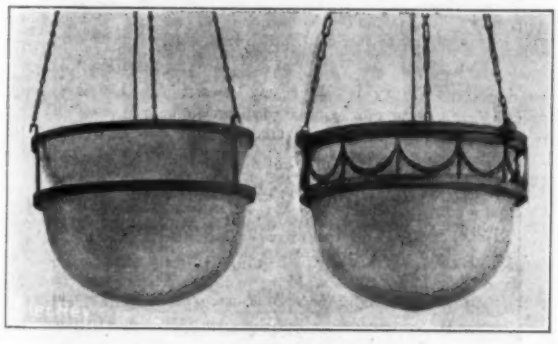


Fig. 10.—Improved Indirect Lighting Fittings.

accumulator cells, and for the remainder of the time energy may be taken from the battery. Separate switches and fuses are provided on the switchboard to control the dynamo, and the house circuit, also for extra circuits where required. A regulating charge and discharge switch is provided for the battery, which enables certain cells to be cut in or out of circuit to obtain the correct voltage. An automatic cut-out protects the battery in the case of the charging current falling below the proper limit. This firm's new "Destro" electric cooking and heating utensils are manufactured exclusively of aluminium, and combine lightness, strength, and cleanliness. Each unit is fitted with a quick-heating element, there are no soldered joints, and the elements are easily replaced. Black ebonised handles are fitted, the construction is strong, with a superior finish. Specimens of electric bells, telephones, flush switches, plugs, and ornamental switch covers, as well as the firm's steel conduit system of wiring are to be seen. Improved indirect lighting fittings, combining the advantages of both indirect and semi-indirect systems, are exhibited, in which indirect illumination is obtained with a special reflector, having two confocal curves on the upper part of the fitting (as shown in fig. 10), the bowl being illuminated at the same time, so that a soft and diffused light is obtained. There is a fine selection of fittings, including alabaster, superlux, and other dash fittings, specially constructed for use with gas-filled lamps. Although not actually exhibited, it may be stated that the firm is bringing out a new form of window reflector light, and also a reflector fitting for studio work, designed on scientific lines.

Messrs. Berry's Electric, Ltd., 86, Newman Street, Oxford Street, London, W. 1.—This "Touch-button" house, with its innumerable electrical devices for dodging drudgery, had a constant stream of visitors and will serve to give some idea of what the real "Touch-button" house will be when it is opened next month at the above address. The name is not altogether a fancy one, for the pressing of a button in the various rooms has a remarkable effect, and the house, comprising artistically decorated rooms, the contents of which are all for sale, contains and is set apart for demonstrations of labour-saving devices. The well-known "Magicoal" electric fires, and "Colec" system of radiant heating, which are the firm's chief specialities, are exhibited to advantage. The actual heat comes from an electric radiator on the hearth, and the coal-fire effect is brought about by reflected light. There are no chimneys in the house, no soot, little dust, and work is reduced considerably. All the rooms are heated by means of a central coal or coke fire to a temperature of 55° F., and the "topping up" is provided by means of electricity. In the kitchen electricity is a regular maid of all work; it appears to play almost a human part all over the house, even to an electric vibrating razor for shaving.

(To be continued.)

FAILURES OF TURBO-GENERATORS, AND SUGGESTIONS FOR IMPROVEMENTS.

At a meeting of the North-Eastern Centre of the Institution of Electrical Engineers at Newcastle, on January 26th, Mr. J. Shepherd read a summary of his paper (which was abstracted in our issues of January 16th and 23rd). In the subsequent discussion Mr. Rosen said he did not agree that turbo-generators were unreliable, as he knew of a machine that was put in 15 years ago and was still running, and had only had a few overhauls. Many of the faults were due to conditions at the stations, but again, many of the shortcomings were being overcome. He thought that if the alternator rotor were removed, and an examination made of the stator windings, a large number of serious accidents would be obviated. Further, he contended that the tendency of modern construction and improvements was to lessen faults due to stresses at critical speeds. Flexible couplings were quite satisfactory when the working pressure was kept within reasonable limits. The author seemed to think that water-cooling would prove the cure for the difficulties raised, but the speaker thought there was in this a great danger, for leaks could not be entirely prevented.

Mr. Jackson said the author referred to the turbine as being first installed in 1903, but before that they had it on Tyneside. In that district many experiments had been made with air cooling. Great difficulties had been met with when spray filters had been used, and also with the cloth filter. The cloth filter was satisfactory while in use, but difficult to clean when out of action. Experiments had been made with water cooling, with a great amount of success. If water cooling were used, and the water allowed to fall to too low a temperature, it might cause condensation. Then there were the failures of the tubes due to age and corrosion. Gas was often taken up, and water taken from a condenser was often very corrosive indeed, but chemical mixtures had been introduced which had overcome the difficulty. He protested against the suggestion that flexible couplings were not satisfactory. He had seen solid couplings used that were the cause of serious vibration.

Mr. Lunn said he had experienced difficulty with corrosion arising from the use of condenser water. He asked whether oil could not be used for cooling purposes instead of water. If a leak occurred it would not be so serious as if water had been used, and if some dropped on the windings probably it would not do much harm. If air were passing through and carried in dirt it would soon cause trouble. The oil would have to be cooled, and that might increase the cost. He had not used water spray, but the air filter seemed to keep the air almost clean, and after twelve months there was very little sign of dirt on the windings. He had had one breakdown caused by a bad joint. He thought it was due to faulty soldering. When the joint was repaired and the burnt portion removed, they found all the conductors of one length were broken down. The longer conductors were supported, but it had not been considered necessary to support the shorter ones, and evidently that was a mistake, because the strain had caused the insulation to break on each of these conductors. He thought it was very necessary that dampers should be fitted to the air-ducts, as they would save a great deal of damage.

Mr. Beard said he did not agree that the old low-speed alternators gave no trouble. He also criticised Mr. Shepherd's statement that "As a rule serious failures with turbo-generators only develop when machines are of large size and form units in a system of some magnitude." The speaker thought that rather the reverse applied, because generally speaking, on large systems the protective arrangements were so much better than on the smaller systems, and a breakdown was less liable to do much damage. With regard to the slip on rotors, he could not recall where side slip had occurred; the conditions were very unsuitable for side slip to take place. Mention had been made of the use of carbon tetrachloride, but he advised great caution in its use. Referring to automatic dampers, he said these were closed by the same relays as cut out the machine in the case of failure.

Mr. Turner and Mr. Patterson also briefly joined in the debate, and Mr. Shepherd replied.

E

At Birmingham, on January 28th, Mr. J. Shepherd's paper on the above subject was read and discussed before the South-Midland Centre of the I.E.E.

Mr. W. Wilson said that anyone who had had marine experience must have realised that the introduction of electric drive would bring about a number of welcome improvements, while at the same time the corrosive effects of the salt air were only too evident to those who had to maintain electrical apparatus exposed to its influences. Among other advantages, the following were the most evident that would be derived from electrical propulsion of ships: The development of power would be centralised; the removal of the inefficiencies of isolated auxiliaries would result in a saving of coal. The increased ease of manœuvring was particularly felt in naval vessels, where greater safety, as well as convenience, would be afforded by electric transmission, through the increased sub-division and isolation that would be made possible. One of the most evident advantages was the absence of the long intermediate shaft, which was responsible for such a large proportion of the breakdowns at sea. The difficulties in the way were not less serious than the author had stated; the principal difficulty was that of cooling the generators.

Mr. W. N. Cranston explained that if they took 15 deg. C. as the approximate difference in temperature required between the iron surface and the air in the duct, and assumed the corresponding difference in the case of water cooling to be negligible, they could permit an internal temperature rise of 15 deg. C. more. If they took 50 deg. C. as the present temperature rise from all sources they could allow 40 per cent. greater loss, provided all other things remained equal. Unfortunately that was not so, since they relied on the cooling from the air gap surfaces of both stator and rotor as a valuable heat path, the efficiency of which depended entirely upon a rapid change of the air in the gap taking place, and in the author's ideal machine it would disappear. In a machine having a stator loss of 200 kw., about 60 kw. would be dissipated from the gap surface of the stator, and a similar amount from the rotor. In the absence of air ventilation the whole of that heat would have to be conducted across the stampings, at the point of highest loss, and he was afraid this would practically absorb the whole of the 15 deg. C. gained. Whatever might be the future of water cooling as an auxiliary, he thought the main cooling medium would continue to be air. They might use a closed circuit with some form of cooling device, which would give absolute cleanliness, and it would be possible to rob the air of its oxygen before admitting it to the machine, and so eliminate the fire risk. A gas had the great advantage over a liquid that the heat in it could be extracted mechanically even though it might be at a lower temperature than its surroundings. This opened up great possibilities of using the turbo losses to some advantage.

Mr. R. G. Jakeman, in common with several other speakers, thought the author had been rather unfair to the present designs of turbo-alternators. The author appeared to have assumed that all channels would be completely filled with the cooling liquid. It seemed quite likely, however, that the centrifugal force would cause the liquid to be flung outwards, leaving a vacuum at the bottom of the slot, which would reduce the surface of liquid available for cooling.

Mr. F. Forrest said the present method of cooling large turbo-alternators could not be regarded as satisfactory. He believed future development would tend towards some system of liquid cooling. There were grave risks in adopting water cooling for the stator of a high-voltage alternator, and he did not believe that this would ever become standard practice. Forced oil-cooling for both stator and rotor would be a satisfactory solution of the difficulty, although the volume of the cooling ducts for oil as compared with those necessary for water cooling would be about two and a quarter times as large.

Swedish Engineers and Higher Piece Rates.—The *Economic Review*, quoting the *Social-Demokraten* for January 14th, says that in support of their claims for higher piece rates as compensation for the shorter working day, the Swedish workers in the engineering industry urge that labour efficiency has risen considerably during recent years; and that greater output cannot be achieved, which is the solution offered by the employers. To substantiate this claim, the Metalworkers' Union has now carried out an investigation, covering 13 large firms in the engineering industry, six in Stockholm and seven in the provinces. It reports that during the years 1914-19 a reduction of 23.9 per cent. in the hours of work has taken place, which affords a measure of the increase in efficiency. The pay per hour has risen on an average 107.5 per cent. during this period. Of this figure, 32.7 per cent. was derived from increases in piece rates, the remaining 74.8 per cent. by increased output. The employers have therefore easily been able to meet the compensation paid for the higher cost of living, and a more sympathetic treatment of the present compensation demands with regard to the 8-hour day might have been expected.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Vacuum Shrouded Immersion Heater.

In our issue of June 14th, 1918, we gave details of a method of heating water or other liquids by means of a heating element immersed in a vacuum flask. The inventor, Mr. L. O. Meyer, has further improved this device by adding a small resistance which reduces the current to a strength just

Fig. 1.—Vacuum Shrouded Immersion Heater.

sufficient to maintain the contents of the flask at boiling point. The inventor states that ¾ pint of water can be kept at 212 deg. F. by a heater taking 4.5 watts from a 4-volt accumulator.

A New Wind Turbine.

Mr. Clarkson, of the Air Power Co., Prestwich, Manchester, has recently developed a new wind turbine, fig. 2. This machine may be constructed in various sizes and types in accordance with the force available in different districts. The diameter of the turbine ranges from 6 to 20 ft., and it is fitted with either single or multiple rotors. A starting and stopping gear is provided, and roller bearings support the

Fig. 2.—The Clarkson Wind Turbine.

rotor. Automatic gear to regulate the force of the wind is also included, and the whole is mounted on a steel tower. In view of the cost and difficulty of obtaining fuel at the present time, any scheme to dispense with it probably constitutes a good financial proposition. Wind-electric plants are already in use in Denmark and elsewhere.

THE GYROSTATIC COMPASS.

By SIDNEY G. BROWN, F.R.S., M.I.E.E.

(*Abstract of paper read before the* Royal Institution of Great Britain, *January 30th*, 1920.)

A gyrostat consists of an accurately balanced spinning wheel, mounted with as little friction as possible, and in such a way that the axis of the wheel may point in any direction in space. Mere translation in space has no action on the instrument; carrying it about, for instance, does not alter the direction of the axis. On the other hand, the gyrostat is acted upon by any force that tends to tilt the axis, or to give the axis a new direction in space.

The wheel is spinning round its axis. Call the direction of this OA. If we impress a force upon the wheel, tending to tilt or rotate it round another axis OB, then the rule is that the spinning wheel will " precess " or move in such a direction

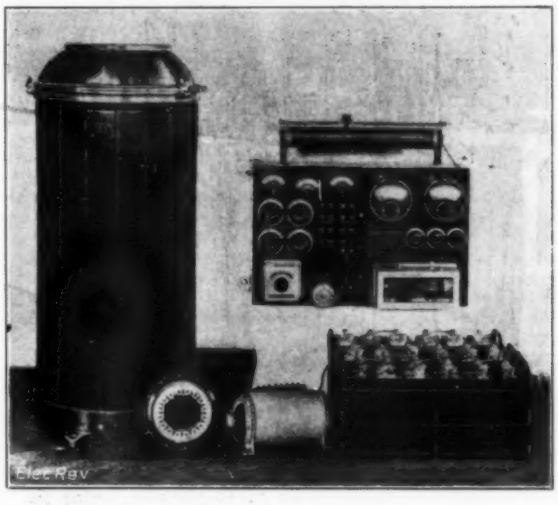


Fig. 1.—Complete Equipment of Brown Gyro-Compass.

as to try to make the two axes OA and OB coincide, and the direction of spin of the wheel to coincide with the new direction of rotation that we are trying to produce by the applied force.

The gyrostat under impressed forces tends to move so as to make the whole angular momentum a maximum. Suppose, therefore, a gyrostat has its axis OA fixed parallel to the earth's surface, but free to turn in " azimuth," as it is called, upon a frictionless vertical spindle, the earth will act upon such an instrument, and it will be a gyro-compass. The earth as it rotates is continually tilting the axis of the wheel in space; the wheel will, therefore, turn so as to set its axis of rotation as nearly as possible parallel to the axis of the earth. It is only when the two axes coincide that the wheel is free of any further tilting action—that is, when it is pointing true north; deviate the axis, however little, from this position of rest, and the action of the earth comes in again to precess the wheel back again to the north.

The use of a gyro-compass on land is very limited, and its great value at the present time is on board ship. Now a rolling and pitching ship is about the worst place to put a gyrostat to act as a compass, because the ship's movements all tend to tilt the axis. The problem, therefore, is to make the compass insensible to the movements of the ship, and respond only to the slow angular rotation of the earth.

To indicate the severity of the ship's movements I may recall a recent trip of this gyro-compass on board a fast destroyer. During a severe gale the ship was recorded to roll over 50 deg. of total angle; yet the gyro-compass maintained its accuracy and allowed the ship to be safely steered into harbour, to which she had to run for safety. In all this whirlwind of movement the gyro-compass heard and only responded to the still small voice of the earth's rotation.

For use on board ship the compass must be mounted on a pendulum in gimbal rings, and its period of oscillation is lengthened to something like 85 minutes, which is usual in practice, so that the rolls, which are of the order of 7 to 15 seconds' period, shall have but small effect on the compass.

In this case the rotation of the earth does not act directly upon the gyro wheel, but by means of the force of gravity through the pendulous weight. Unfortunately this form of mounting introduces troubles of its own.

Suppose the spindle is pointing west, and is horizontal, then the earth as it rotates will leave the wheel pointing in this one direction in space, but the weight will try and follow the earth's rotation, and will start precessing the gyro towards the north. The rate at which the wheel comes to the north depends upon the weight attached to the casing. All the time the wheel is coming to the north the earth is adding to the rate of the precession, and the spindle is as a consequence tilted, and is deflecting the weight, at the north position. Under these conditions the effect of the weight is to continue the precession, and the gyro wheel will swing through the north position, and will continue to move until the effect of the earth arrests and reverses the motion. The compass will therefore continue to swing through the north position with constant amplitude backwards and forwards, undamped. To render the compass of use, some method of damping the swing must be introduced, so that the compass may finally settle on the north. Friction between the vertical spindle and its support is inadmissible, because the movements of the ship would react through the friction and cause errors in the reading. Anschutz, in his early form of compass, by use of an air blast gets rid of this connection with the ship. The air blast was arranged to oppose the movement in " azimuth " when the wheel tilted, and thus he obtained an effective method of damping. The strength of the air blast, which varies proportionally to the tilt, should be nothing when the compass is at rest on the north—that is, when the tilt is nothing—and this would be true with the compass on the equator. In other latitudes, however, the compass rests at the north with a tilt still remaining. It does not come back to the horizontal position because the axis of the wheel is trying to set itself parallel to that of the earth. This leaves a residual air blast continuously acting, producing a permanent twist in " azimuth " and a constant error. It is therefore preferable to damp the swings of the compass by acting upon the tilt rather than its movement in " azimuth," because in this case there will be no latitude error. The tilt is a maximum at the middle of each swing—that is, when it is moving through the north position—and it is the return of the weight to its truly vertical position that is responsible for the continuation of the oscillation. We therefore require some method of neutralising the action of the weight, not before, but after the compass has reached the north. This I accomplish in the " Brown " gyro-compass by automatically moving a liquid from one bottle to another, and in such a direction as to counterbalance the weight, precessing the gyro wheel; and I delay its action by means of a valve or constriction in the tube joining the two bottles.

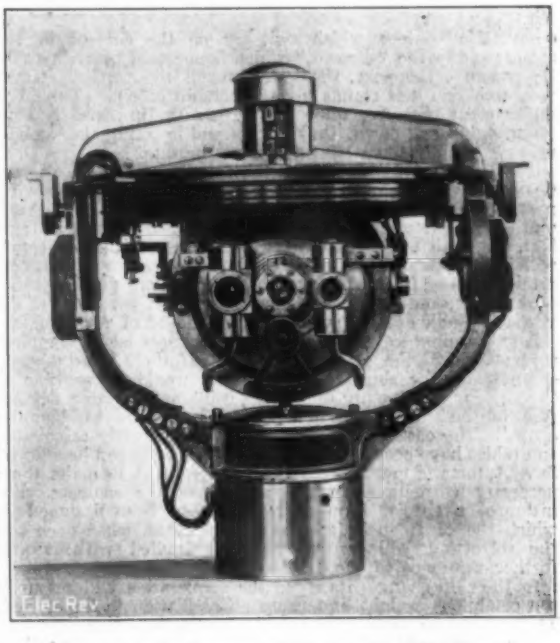


Fig. 2.—Gyro-Compass Removed from Binnacle.

The force with which the compass seeks the north is proportional to the product of the rotation (one revolution in 24 hours) and the spin of the wheel. In the " Brown " gyro-compass the wheel, which is 4 in. in diameter and 4½ lb. in weight, runs at 15,000 revolutions per minute. The maximum directive force of the earth on this wheel, that is when the spindle is pointing east to west, is only the weight of 30 grains with a leverage of 1 in. This small force is continually

diminishing in value as the axis approaches the north direction, and vanishes absolutely in that position. If the compass be deflected, say 1 deg., from the north, then the force of restoration is only ¼ grain at a leverage of 1 in. It will therefore be seen how important it is to eliminate as completely as possible any friction on the vertical axis that would tend to oppose the directive action of the earth.

There are three forms of gyro-compass now in use, the Anschutz (German), the Sperry (American),* and the "Brown" (British).

In the "Anschutz," the vertical axis is supported by a bath of mercury; in the "Sperry" by a suspended wire, the twist, if any, being taken out by a follow-up motor, through an electric contact which switches on the current to the motor; and in the "Brown," which is operated by an hydraulic system of support, the lower end of the vertical spindle acts as a ram and stands upon a column of oil. The oil is under great pressure, some 500 lb. per sq. in., and is kept pumping up and down, thus raising and lowering the vertical axis continually some 180 times every minute.

The continual movement of the spindle results in a practically frictionless vertical support, so that the total moving part, some 7¼ lb. in weight, can be carried round in "azimuth" by the smallest force, due to the earth's rotation; in fact, so small is the friction that the compass, if deflected, will always come back again to its true north position, certainly within 1/10th of a degree. I think I am safe in saying that it is the most perfect frictionless support yet given to the vertical spindle of any gyro-compass or indeed of any machine.

A ship sailing to the north at, say, 20 knots would complete a revolution of the globe in 45 days. If there were a gyro-compass on the ship, the instrument would be sensible of the angular movement, and would point one or more degrees west of the actual pole; this is termed the "north steaming error." The extent of the error can be accurately calculated, and tables have been prepared so that this error can be allowed for. Automatic means have also been devised to make these necessary corrections in the reading of the compass. For instance, a special form of repeater has been designed in which the card can be set eccentric, so that, when once set, the correction will be automatically applied without any further reference to the tables.

As the ship changes its speed the acceleration will act upon the pendulous weight and cause an oscillation to be started. This oscillation is termed the "ballistic deflection."

The permanent north steaming error and the transitory error, due to the ballistic deflection, are in the same direction, and mathematicians have calculated that with an undamped gyro-compass, if the time of its oscillation is set to 85 minutes in any particular latitude, the ballistic deflection can be made exactly the same as the deflection due to the north steaming error; this being so, the compass should move into its new resting place without further oscillation.

This would be true if the compass were undamped; but all gyro-compasses are damped, and the ballistic deflection must, therefore, include a term due to the damping.

This damping term up to the present has been neglected, but in practice it is found that when a ship is steaming and turning to alter its course, the compass does not come dead-beat to its new position, but has an oscillation started which is common to all existing gyro-compasses. On a merchant ship the damping error is of little moment; but on a war vessel which is manœuvring it may be serious, as it may swing the compass off its correct reading by several degrees. I have made certain modifications in my compass to remove the damping error.

FIG. 3.—BINNACLE AND GYRO-COMPASS.

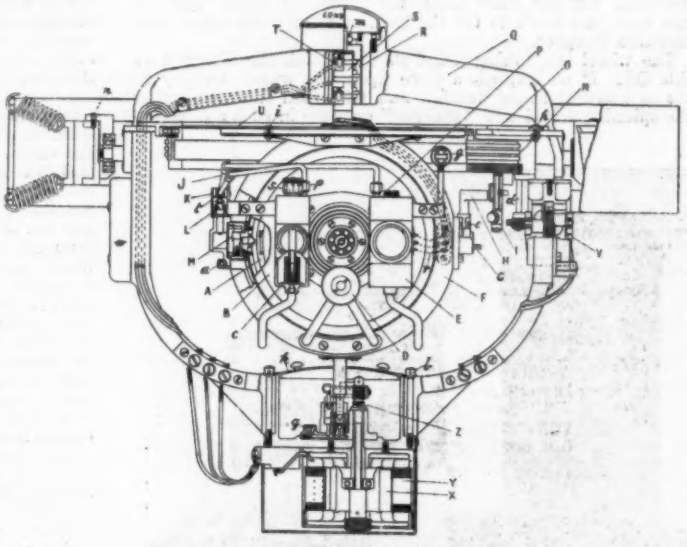


FIG. 4.—DETAILS OF BROWN GYRO-COMPASS.

A, gyro-wheel; B, casing, carried on knife edges; C, damping bottle; D, quadrantal weight; E, control bottle; F, supporting ring; G, adjusting screw for E-W balance; H, air blast for repeater control; I, air contact-maker; J, air pipes; K, air box; L, air jet; M, knife-edge; N, follow-up ring; O, ring on which lubber-line is marked; P, screw stoppers; Q, main pendulum on ball bearings; R, mercury contact rings; S, slip rings; T, mercury cups; U, compass card; V, step-by-step motor for turning follow-up ring N; X, rotor of pump motor; Y, stator; Z, ball-bearing thrust block; *a*, adjusting screw for air jet; *b*, screws; *d*, intermediate spindle; *e*, adjustment for repeater air blast; *g*, spirit level; *h*, *i*, screws for adjustments; *k*, cover; *m*, ball-bearing guide for vertical axis; *n*, screws; *p*, pipe sockets; *q*, suction valve for oil pump; *r*, flexible leads to gyro stator; *s*, divided screw head of damping valve; *t*, cover of air box; *v*, oil cup for gyro wheel; *w*, counterweight.

The last, but by no means the least, of the errors that may arise if the instrument is not properly designed, was not known when the gyro-compass was first brought out, and it proved a most difficult fault to correct; its elimination has had more to do with the design of the later forms of gyro-compasses than any other factor. If a gyro wheel is precessed towards and kept pointing to the north by an ordinary pendulum weight it will work well on board ship, provided that the ship is steaming on a fairly smooth sea; but if the direction of the compass points anywhere in the quadrants—that is, N.W. or N.E., S.W. or S.E.—and the ship rolls, the wheel will try to set itself so as to bring the rim of the spinning wheel in line with the roll, and in a long, continued and heavy roll the compass may show an error of 20 or more degrees, a most serious fault, and one that would render the instrument quite useless in a heavy sea. This error is called the "quadrantal error." If the compass points direct N.S.E. or W. the error is nothing, but it would be a maximum in any of the directions before mentioned.

Anschutz gets rid of the error by multiplying the number of his gyro wheels, and by constructing the instrument as symmetrical as possible. In the year 1914 the Sperry Co. claimed to have effected a cure for the error by attaching the pendulous weight, not directly to the gyro casing, but through a pin arranged to move in a slot in the casing.

In the "Brown" compass the quadrantal error is eliminated by making the weight operate completely out of phase with the roll—that is, at 90 deg. displacement.

The "Brown" gyro-compass is shown diagrammatically in fig. 4. A is the gyro wheel in its casing B. This case is carried on knife edges M in the vertical ring F, and is thus free to tilt under the action of the rotation of the earth. The vertical ring turns in azimuth on a frictionless mounting, consisting of an oil pump at the bottom of a ball-bearing *m* at the top. XY is the three-phase motor that drives the oil pump.

The gyro wheel is the rotor of a three-phase motor, and current is led into the moving system through the three sets of iron contact rings R and S. These rings do not touch, but the outer set are hollow, and mercury fills the space between them, so that there is little friction.

The vertical ring is dynamically balanced by two projecting weights D. Q is the pendulous mounting, supported by gimbal rings and by the outer row of springs to take up shock.

* The Anschutz compass was fully described in the ELECTRICAL REVIEW for December 1st, 1911, and the Sperry in the issue for June 6th, 1913.

The gyro wheel runs at 15,000 revolutions per minute, and thus acts as a powerful blower, giving an air-pressure equal to some 3 in. of water. Fixed to the vertical ring, but connected through the hollow bearing *m* to the inside of the case, is the air jet L. This jet blows into the two halves of the air box K, and thence through the pipes J. The air-pressure is thus transmitted to the oil in the two sets of bottles C and D.

H is another air jet similarly mounted and employed to act upon a pair of contact-making vanes I. The contacts,

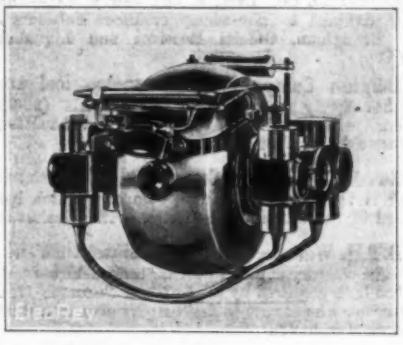


FIG. 5.—GYRO WHEEL IN CASE.

through the agency of the controller which is fixed on the switchboard, work the repeaters and the step-by-step motor V. This motor forces round the follow-up ring N to keep the contact-making vanes I always opposite the air jet, and in doing this all the repeaters on the ship follow suit.

U is the compass card fixed to the upper portion of the vertical ring, and O is the lubber line support. By removing the four screws marked *n* the gyro-compass can be completely removed from the gimbal rings. The instrument thus removed is shown in fig. 2.

When the case B is horizontal, the bottles E are half full of oil, and the air jet L is blowing equally into the two halves of the air box K; but when the case tilts, the air pressure blows into one side of the box more than the other, and in such a direction as to force the oil from the lower bottle into the one raised. There is, therefore, a considerable righting troque indicated by the weight of the oil trying to restore the case to the horizontal.

When the pendulum swings under the action of the rolls of the ship the air jet L moves from one side to the other side of the air box in tune with the roll, blowing the oil periodically from one bottle to the other. At the middle of the swing of the pendulum the air jet is at the middle of the air box, and there is no difference of air pressure, and therefore no movement of the oil; and when the swing is at the end of its path and not moving, the air jet is at one side of the air box and producing the maximum movement in the oil. It will therefore be seen that the movement of the pendulum and the movement of the oil are out of phase with each other. It is for this reason, given good dynamic balance, that there is no quadrantal error whatsoever with this method of control.

Fixed to the same air box K are the two damping bottles C, but the air here acts in the opposite direction. In one of these damping bottles is an adjustable needle valve; this valve has a constricted passage, and thus the flow of oil from one bottle to the other is suitably retarded.

As regards the accuracy of the compass, one on board a flagship in the North Sea during the war was observed with particular care, especially during very heavy weather, and it was reported that it was never more than 1½ deg. from the true north position during the whole of the tests.

Trials on a commercial ship have demonstrated the fact that the employment of a gyro-compass resulted in the ship steaming every day over 3 per cent. greater mileage; in other words, one day's steaming in thirty would be saved, resulting in a proportionate saving in coal and all other expenses.

BUSINESS NOTES.

Lead.—Messrs. James Forster & Co. report under date February 7th:—

During the last two market days there has been a good demand at steadily advancing prices, and at the end of yesterday's session values showed a rise of fully 25s. per ton on the week. The closing prices are £48 15s. February, £48 17s. 6d. March, £49 April, £49 5s. May, and £49 10s. June, with buyers over. The week's turnover is well above 5,000 tons.

Controlled lead has not been available during the current week, and the authorities are still reluctant sellers, their price being nominally £49 net ex warehouse.

A fair quantity of Australian lead has arrived recently, but, owing to the delay in obtaining berths, steamers are extremely slow in discharging, and this is causing considerable inconvenience in some directions. A small quantity of Spanish lead is arriving shortly, but very little permanent relief is to be expected from this quarter.

We can see no prospect of any early change in the intrinsic position, and consequently we can only look for a continuance of firm markets tending towards higher values.

Messrs. G. Cawson & Co. report:—

These are the highest prices recorded in the history of the trade, and it is remarkable to see what a strong combination can do in controlling a market when it is backed by ample financial resources. The position with regard to supplies remains unchanged—there is still ample stock of available lead, and with the quantities now coming forward, consumers may rest satisfied that there will be always plenty of lead to meet their requirements. Consumers have again taken small parcels. There has also been a little inquiry and business done for export. Germany, however, is reported to have resold lead here, which they had bought for consumption. The position generally is so confused and so much mixed up with the fluctuations of exchange, that it is impossible to prognosticate anything definite as to the future. So long as speculators continue to control the market, as they are now doing, the price must be maintained. It looks as if the consumer may have to wait a long time for cheap lead.

Applications for British Trade Marks.—Appended is a summary of the recent applications for British trade marks in respect of goods connected with the electrical industries:—

Agpom. No. 396,624. Class 13. Electric incandescent lamps. Aladdin Renewed Electric Lamp Corporation, 82, Victoria Street, London, S.W., October 30th, 1919.

Jiffysweep. No. 387,572. Class 6. Electric and hand-driven vacuum cleaners. Electrical Appliances Co., Ltd., 8, Fisher Street, Southampton Row, London, W.C., January 14th, 1919.

Bizzysweep. No. 387,573. Class 6. Electric and hand-driven vacuum cleaners. Electrical Appliances Co., Ltd., 8, Fisher Street, Southampton Row, London, W.C., January 14th, 1919.

Jiffyklean. No. 387,574. Class 6. Electric and hand-driven vacuum cleaners. Electric Appliances Co., Ltd., 8, Fisher Street, Southampton Row, London, W.C., January 14th, 1919.

Bizzyklean. No. 387,575. Class 6. Electric and hand-driven vacuum cleaners. Electrical Appliances Co., Ltd., 8, Fisher Street, Southampton Row, London, W.C., January 14th, 1919.

Sentinel. No. 395,441. Class 8. Electrical cutouts for indicating failure in the oil feed of internal-combustion engines. Hendrick W. Moerman, 43-6, Southampton Buildings, Chancery Lane, London, W.C., September 22nd, 1919.

Philec. No. 395,698. Class 8. Electric batteries. Philadelphia Storage Battery Co., Ontario Street, Philadelphia, U.S.A., October 2nd, 1919.

R.M. (letters embodied in design). No. 395,963. Class 8. Instruments used in radio telegraphy and telephony, and parts of same. R.M. Radio, Ltd., 5, Chancery Lane, London, W.C., October 10th, 1919.

Atmos. No. 390,855. Class 13. Sparking plugs. Arthur Cox, "Harlech," Warwick Road, Olton, Birmingham, May 5th, 1919.

Oojah. No. 397,063. Class 13. Sparking plug testers. Changeable Sign Co., Ltd., Chippenham Works, Shirland Road, London, W., November 10th, 1919.

Utility "Autopax" electric cooker (lettering combined with design). No. 395,381. Class 18. Electric cookers. Automatic Telephone Manufacturing Co., Ltd., Milton Road, Edge Lane, Liverpool, September 19th, 1919.

Olmadun. No. 397,581. Class 6. Electrical and other appliances for operating proscenium curtains. Oliver & Dunbabin, 9, Fenchurch Buildings, London, E.C., November 25th, 1919.

Metrovick. No. 396,424. All goods in Class 6. No. 396,425. All goods in Class 8. No. 396,426. All goods in Class 13. Metropolitan-Vickers Electrical Co., Ltd., 2, Norfolk Street, Strand, London, W.C., October 23rd, 1919.

Series of ten designs comprising initial letters V.M. No. 396,903. Class 8. Metropolitan-Vickers Electrical Co., Ltd., 2, Norfolk Street, Strand, London, W.C., November 9th, 1919.

Machinery and Electrical Trade of Hongkong.—In a recent report on the trade of Hong Kong the U.S. Consul remarks that with the war in Europe drawing all possible strength from the factories of the United States and Europe, and with uncertain finance and scarcity of raw materials in sight, it was but natural that imports of machinery of all sorts were comparatively small. What trade there was came mostly from the United States, but the chief other feature of the year was increasing competition from Japan and from China itself in many lines of standard machinery. High costs prevented any advancement of new enterprises, while all other demands were held down to a minimum for the same reason.

In the Consul's opinion, the laid-down cost of most standard machinery, including locomotives and cars, machine tools, boiler-shop supplies, and equipment, blacksmith-shop equipment, and all similar goods, will average about 200 per cent. of pre-war prices even allowing for favourable exchange, while the increase in cost in Hong Kong of electrical goods and equipment will be 100 to 200 per cent. Power-house equipment has increased 150 per cent. on an average. War restrictions on the export of machinery also served to reduce trade, for uncertain deliveries made it impossible to develop any other than the most pressing enterprises.

In electrical supplies and equipment actual imports were small. The chief Hong Kong power concern ordered several machines in the United States for its new plant, some of which arrived before the end of the year; and the chief Canton power concern ordered a complete new plant in the United States, though none of the equipment was actually delivered during the year. Arrangements have been made for the reorganisation and re-equipment of other power concerns though orders have not yet been placed. In electrical supplies, Japanese competition has especially been felt. The Japanese factories have been turning out cheap fittings, lamps, fans, wires, cables, conduits, small motors, and all similar goods at prices which cannot be touched by American and European manufacturers for standard goods. These goods are cheap and flimsy, but for the time being at least they answer the needs of the ordinary Chinese user and have, and will continue to have, a large share of the trade in this line. Electric lamps and a considerable line of fittings and supplies also are being made in China itself. Competition in such lines in the immediate future between American and European standard goods and these cheap local supplies will be very keen, and it is probable that only by long and somewhat costly experience will the Chinese consumer learn that standard goods are economical in the long run.

Liverpool Electrical Lockout.—In Liverpool a more serious view is being taken of the effect of the present trouble between the National Federated Electrical Association and the Electrical Trades Union on the question of the recognition of the new code of working rules, which had been approved by the District Joint Industrial Council, but had not been ratified by the National Joint Industrial Council, and could not therefore be put into operation. A large number of firms not in the Association immediately accepted the new terms, as well as a few of them in the Association after a lock-out was declared. The E.T.U. had in operation a rule limiting overtime, and by lifting the ban for one month, appear to be endeavouring to use the employers who have submitted to the rules, against those who have not. There is plenty of work at Liverpool at the present time, as well as a demand for electricians, and what the outcome of the present dispute will be so far as concerns the Joint Industrial Council, which was set up to eliminate labour troubles, can only be conjectured, but there is a very pronounced feeling of its failure to meet circumstances. The root of the trouble is that the E.T.U. claims that the new rules do not require ratification by the National Joint Industrial Council, whilst the Association contends that the rules agreed upon with the E.T.U. were merely recommendations to the National Joint Industrial Council. Our local correspondent remarks that it appears that at the outset it should have been made clear what are the respective functions of the National and the District Councils.

Manufacture of Telephone Material in Czecho-Slovakia.—Two engineers named Capek and Umbach, with experience obtained in Europe and the United States in the manufacture of telephone apparatus, are planning to start a factory in Prague for the production of such goods, including telegraph as well as telephone instruments, railway signalling apparatus, and telephone equipment generally. The Ministry of Posts and Telegraphs is said to be interesting itself in the venture, as also is the Zivnostenska Bank, Prague.

Electric Fires in Demand.—The Arora Co., of Loughborough, informs us that, owing to the enormously increasing business in electric fires, its sales have again doubled this year (had it not been for the 18 weeks moulders' strike, they would have been trebled), and it is continually appointing new agents in the various territories. The present British agents of this company are at London, Manchester, Liverpool, Bradford, Newcastle, Birmingham, and Glasgow.

Understamped Letters.—The Department of Overseas Trade continues to receive complaints from British Consular representatives abroad regarding the insufficient stamping of letters from Home firms. A case is mentioned in the *Board of Trade Journal* of a Consular official in France who had to pay 3·50 fr. on an advertising almanack. Presumably many other recipients had a like experience. Is such remissness likely to promote friendly business relations? If correctly stamped and wrapped, the postage on the almanack in question would have been 3d.! In regard to letters, the use of special coloured envelopes has much to commend it as a means of preventing errors when the posting clerk is rushing things off to catch the mail. Is not hurry at post-time preventible in a well-organised office?

Dissolutions and Liquidations.—F. A. Jennings, Ltd.—Upon the petition of Messrs. Bruntons, of Musselburgh, the voluntary winding-up of this company has been ordered to be continued under the supervision of the Court. Joint liquidator appointed: Mr. E. H. Hawkins, 4, Charterhouse Square, E.C.

Thacker, Bell & Co., Ltd., 44-46, Leadenhall Street, London, E.C. 3.—This company is winding up voluntarily, with Mr. C. Hirst, as liquidator. Meeting of creditors, February 19th, at the Institute of Chartered Accountants, Moorgate Place, E.C.

Rhymney Valley and General Electric Supply Co., Ltd.—Meeting called for March 6th, at 4, Cathedral Road, Cardiff, to hear an account of the winding up from the liquidator, Mr. C. Carpenter.

Preece, Cardew, Snell & Rider, consulting engineers, 8, Queen Anne's Gate, S.W.—Messrs. A. H. Preece, Sir J. F. C. Snell, J. H. Rider, and J. H. Woodward, have dissolved partnership. Debts will be attended to by Messrs. A. H. Preece, J. H. Rider, and J. H. Woodward, who will continue the business at the same address, under the title of Preece, Cardew & Rider.

Lee, Bufton & Elliott, electrical engineers, 10, Porter Street, Sheffield.—Messrs. W. Marples, H. Bufton, and W. Elliott, have dissolved partnership. Messrs. H. Bufton and W. Marples will attend to debts, and continue the business under the style of Lee & Bufton.

The Electrical Co., Ltd., 6, Old Jewry, E.C.—Last day for proofs for dividend to non-enemy creditors, February 21st. Mr. H. de V. Brougham, Official Receiver and Liquidator, Carey Street, W.C.

New Belgian Company.—A new electrical engineering company has lately been formed in Brussels (30-32, Rue de Treurenberg), with a capital of 500,000 fr., and the title La Société Manufacture d'Appareillage Electrique Nicca.

New Swedish Wireless Company.—The Svenska Radio Aktiebolag is the name of a new company which has recently been formed in Stockholm in connection with wireless telegraphy.

New B.T.H. Works.—*The Times* states that the Government cartridge factory at Blackheath, Staffordshire, erected during the war, has been acquired by the British Thomson-Houston Co., Ltd., of Rugby, who expect to find employment in a short time for some thousands of hands.

Catalogues and Lists.—Associated Fire Alarms, Ltd., Jewin House, Redcross Street, E.C. 1.—Two booklets, "Automatic Fire Detection," and "Our Record," describing various systems of alarms.

The Overseas Engineering Co., Ltd., 75, Curtain Road, E.C. 2. List No. 36 (second edition), dealing with "National" motors and dynamos. Net c.i.f. prices are given.

Haywood Foundries, Ltd., 30-32, Seaton Street, Euston Road, N.W. 1.—Catalogue dealing with castings in non-ferrous metals, illustrated by micro-photographs of materials. Comparative tests of Haywood's high-tensile bronze and mild steel are given.

Building Products, Ltd., Columbia House, 44-46, King's Road, Sloane Square, S.W. 3. Eight-page booklet, dealing with "Rigifix" bolt-hanger sockets and slotted inserts for use in reinforced concrete factory building. Illustrations of installations are given.

New French Electrical Companies.—The Société Hydraulique Tunisienne has been formed at Paris for the construction of electric plant of all kinds for the generation and distribution of electric energy. Its capital is 500,000 fr.

La Société d'Entreprises de Reseaux Electriques is the name of a new company which has lately been formed in Paris (33, Avenue des Champs Elysees), with a capital of 1,000,000 fr.

With a capital of 1,000,000 fr., the "Aladdin," Société Anonyme, has been established at Paris for the manufacture, purchase, and sale of all kinds of electric material, and especially glow and other lamps.

The Société Marocaine de Distribution d'eau, de Gaz, et d'Electricité has decided to raise its capital from 5,000,000 to 10,000,000 fr.

Under the style of Docks Electriques Français, Bosio, Durand et Cie, has been formed at Marseilles, with a capital of 500,000 fr., to carry out electric installations.

There has been formed at Bordeaux the Comptoir Electrique de France, Etablissements Besse, Darasse, et Buson Réunis, with a capital of 300,000 fr., for trade in electrical apparatus and general electric supplies.

With a capital of 340,000 fr., the Etablissements Nay, of Paris, have been constituted a company for the carrying out of electric installations.

The Société des Moteurs et Appareils Electriques Lilliput has been established at Paris, with a capital of 500,000 fr., for the manufacture of the motors and apparatus bearing the name of Lilliput.

The Société Industrielle d'Electricité has been established at Paris for the manufacture and sale of all kinds of electrical requirements. The capital is 750,000 fr.

Eve, Noizet et Cie have been formed into a company, with headquarters at Paris, for the manufacture, purchase, and sale of all kinds of electric motors. The capital of the new concern is 200,000 fr.

There has been formed at Grenoble, under the style of La Dauphinoise Electrique, a company whose object is the making, repair, and sale of electrical material. The capital is 300,000 fr.

With the designation of Société d'Entreprise d'Electricité has been constituted at Paris a company, with 25,000 fr. capital, for the carrying out of electrical installations.

For the acquisition and working of an electric apparatus business, MM. H. Boucket and E. Aubignat have formed themselves into a company at Paris, with a capital of 50,000 fr.

There is a question of forming a company at Rennes for the supply of electricity to the district centres of the Province of Brittany. The title of the proposed company is to be l'Electricité en Brétagne.

Marine Motor Exhibition at Olympia.—A Motor Boat and Marine and Stationary Engine Exhibition will be held at Olympia from March 12th to 20th. A number of electrical and allied manufacturers are exhibiting, and it is stated that nearly all the space has been let.

Book Notices.—A *Handbook* of the Library of Commerce attached to the Bristol Municipal Public Libraries has been issued. It not only contains lists of all trade and technical books, directories and journals that are on file, but also particulars of the principal subjects covered in these publications, the references being kept up-to-date in the form of a card index at the library. There are one or two slips, such as the reference to *The Times* Engineering Supplement being "weekly" whereas it is monthly, but the publication is likely to be very convenient for visitors' use. The city librarian will welcome additional commercial literature, including trade catalogues.

"Volumetric Tests on Scientific Glassware, Class A Tests, and Class B Tests," 35 pp. Volumetric glassware has been tested on a small scale at the National Physical Laboratory for the past 15 years. With the growth of the industry in this country, it was felt that the scope of the work should be widened, and consequently, a new building has just been completed at the Laboratory specially equipped for dealing with this class of work on a large scale. In addition to the tests of scientific accuracy, provision has been made for testing apparatus intended to possess only commercial or Class B accuracy. A full account of the tolerances allowed, methods of test, details of construction, test fees, &c., is given in the new edition of the Laboratory Test Pamphlet, copies of which may be obtained, free of charge, from the Director, The National Physical Laboratory, Teddington, Middlesex.

"Welfare Work," Vol. I, No. 1. The *Journal* of the Welfare Workers' Institute, 16 pp., price 2d. (monthly).—Devoted to articles on the various aspects of "welfare" work in industry by well-known authorities, and to reports of the activities of the Institute and its members.

"New Forms of Instruments for showing the presence and amount of Combustible Gas in the Air." By E. R. Weaver and E. E. Weibel. 44 pp. Scientific Paper, No. 334, of the U.S. Bureau of Standards. Washington: Government Printing Office. 15 cents. —This paper describes three types of instrument for gas detection, all depending upon the combustion of the gas in the surrounding atmosphere by an electrically-heated wire. This surface combustion takes place at a temperature much lower than the normal ignition temperature in air. The instruments dealt with are the "compensated bridge indicator," the "glowing wire indicator," and the "bimetallic detector." The publication is illustrated by diagrams and curves recording the instruments' performances.

"Constants of Radiation of a Uniformly-Heated Enclosure." By W. W. Coblentz. 7 pp. Scientific Paper, No. 357, of the U.S. Bureau of Standards. Washington: Government Printing Office. 5 cents.—Giving the results of experiments and investigations to ascertain the coefficient of total radiation of a so-called "black body" with corrections for reflection losses.

Institution of Civil Engineers.—"Abstracts of Papers in Scientific Transactions and Periodicals" (new series). January, 1920, No. 2. London: The Institution.

"The Telegraphists' Guide." By Bell & Wilson. Pp. xiv + 258, figs. 178. London: S. Rentell & Co, Ltd. Price 5s. net. In this, the eighth edition, the chapters have been re-arranged and the subject matter brought up-to-date. A new chapter on central battery working has been added, and the sections dealing with concentration switches, and the "Megger" and "Bridge-Megger," have been expanded.

"Telephonic Transmission." By J. G. Hill. Pp. xiv + 398, figs. 185. London: Longmans, Green & Co. Price 21s. net.

"Vickers' News." Vol. I, No. 9, 16 pp. London: Vickers, Ltd. Includes articles on surface hardening and porcelain fittings production.

"*Journal* of the Institution of Electrical Engineers." Vol. LVIII, No. 287. January, 1920. London: E. and F. N. Spon, Ltd. Price 10s. 6d. This issue contains the following papers:—"The Design of Multiple-Stage Amplifiers using Three-Electrode Thermionic Valves," by Prof. C. L. Fortescue; "Carbon Arcs for Searchlights," by Messrs. C. C. Paterson, J. W. T. Walsh, A. K. Taylor, and W. Barnett; "The Short Tungsten Filament as a source of Light and Electrons," by Mr. G. Stead; and an address to the Students' Section by Mr. A. P. Trotter.

"The British Dominions Year Book for 1920" has been issued (1s.) by the Eagle, Star and British Dominions Insurance Co., Ltd. It contains many interesting articles on industrial, financial, trade, housing, shipping, transportation, female labour, science and the war, and other questions; also a good deal of matter relating to post-war events, war honours, &c.

"*Journal* of the British Science Guild," No. 10, January, 1920, 49 pp., price 6d. (7½d. including postage).—Among the subjects dealt with are the "Need for Rewarding Medical Discovery," and "Science and Labour." Copies of the *Journal* may be obtained from the Secretary, 6, John Street, Adelphi, W.C. 2.

"Thermal Expansion of Insulating Materials," Scientific Paper No. 352 of the U.S.A. Bureau of Standards. 31 pp., price 10 cents. Washington: Government Printing Office.—This publication gives data relating to the thermal expansion of the more important insulating materials such as porcelain, fibre, hard rubber, bakelite, &c.

Bankruptcy Proceedings.—Walter Henry Mellon, electrical engineer, late trading as H. B. Wallis & Co., 37, Elliott Road, Chiswick, Middlesex, late 43, Turnham Green Terrace, Chiswick.—The Receiving Order in this matter was made on debtor's petition. It appeared from the statement of affairs submitted that the liabilities amount to £384, and assets £155, thus leaving a deficiency amounting to £228. Debtor commenced business on his own account four years ago at a small workshop at Chardin Road, Chiswick, with a capital of £50 to £60, and in June, 1917, in partnership with another, he opened a shop at 49, Turnham Green Terrace, under the name of H. B. Wallis & Co., his contribution being about £50 worth of stock, and the partners £50 and a few fittings. The business was carried on successfully, and in September, 1918, another shop was opened at 43, Turnham Green Terrace, and in February, 1919, the partner took over the premises at 49, Turnham Green Terrace, and the partnership business was continued at No. 43. In August, 1919, the partnership was dissolved, the debtor paying his partner £60 for his interest, and he carried on the business until December 12th, 1919, when he sold the goodwill, fittings and fixtures for £100, which was mostly paid to creditors. These payments are being further inquired into. Debtor states that he did not become aware of his position until December 12th, 1919, when the business was sold. Debtor alleges as causes of failure mismanagement of business during his illness. At the first meeting of creditors held last week, the matter was left in the hands of the Official Receiver.

W. H. Howard (Holborn Electrical Co.), electrical engineer, 5, Featherstone Buildings, Holborn, and Finsbury Park, N.—Application for debtor's discharge will be heard February 27th, at Carey Street, W.C.

Trade Announcements.—The electrical repair shop of Messrs. Robinson & Hands Electrical Co., Ltd., is at Aston, not Ashton, as stated here last week.

Messrs. Barnett & Soans, of Kettering, have opened a further branch at 8, Sheep Street, Wellingborough, under the management of Mr. L. E. Troath, late of the Wellingborough Electric Supply Co. Manufacturers' and agents' lists are wanted there.

The Electrical Contracting and Motor Co., of which Mr. G. Mercer is manager, has opened new works and showroom premises at Pontefract Road, Castleford.

Messrs. Slack & Clarke, electrical engineers, of Rotherham, having dissolved partnership, the business will be continued under the management of Mr. J. Slack.

Mr. A. R. Walmsley, who purchased from the trustee the business of Mr. George Hill, electrical, mechanical, and tramway engineer, of Trafford Electric Works, Manchester, and formed the business into a private limited company (Geo. Hill & Co., Ltd.) in 1910, has transferred his controlling interest to Mr. J. H. Edwards.

Mr. G. B. Broughton, of the General Electric Co., Birmingham, has been appointed manager of the Midland branch of the Electrical Apparatus Co., Ltd., of London, S.W. 8, in place of the late Mr. A. G. Way. The address of the branch office is:—Carlton House, High Street, Birmingham. Telephone No.: "Central 7478." Telegraphic address: "Elapratus, Birmingham."

As we go to press we learn that the businesses of the Electrical Apparatus Co., Ltd., and Messrs. Bray, Markham & Reiss, Ltd., have been amalgamated. We shall give further particulars next week.

Messrs. E. & C. Gates, since demobilisation, have recommenced business at 56, London Street, Norwich, where they are engaged upon all classes of electrical installation work and advertising signs. They have issued an eight-page illustrated publication on country-house lighting.

Payment By Results.—*The Times* states that 600,000 members of the engineering Trade Unions are to ballot on the question of payment by results. The ballot will be taken at an early date. Conferences recently held at York between engineering employers and workers failed to arrive at any agreement on this question.

The *Daily Telegraph* stated, on Wednesday, that an important industrial agreement between the Engineering and National Employers' Federations and the many Trade Unions included in the National Federation of General Workers had resulted from the recent private conferences at York, and was to be submitted to the constituent bodies for acceptance. The proposals relate to a 47-hours' week, and are standard, and not minimum. The question of a two-shift day or three-shift system is left over for another conference. Employers are to be permitted to introduce systems of payment by result, a much-vexed question, on specified conditions. Piece-work prices and bonus or basis times are to be such as will enable workmen of average ability to earn at least 33⅓ per cent. over the present time rates, excluding war bonuses. No Union workman is to be required to work more than 32 hours' overtime in any four weeks after full shop hours have been worked, allowance being made for time lost through recognised causes. A special conference is to be held to discuss the schemes of payment by results, such to include those who contribute to production without being direct producers. The consolidation of war wages is also for future consideration.

Social.—The 14th annual concert of the Bradford tramway employés took place on February 3rd at St. George's Hall. The Tramway Department Military Band was in attendance.

Catalogues Wanted.—Mr. J. C. Elvy, of Loughboro', Westland Road, Watford, would be glad to receive catalogues of all electrical appliances used in film production studios, hotels, &c.

Foreign Trade.—January Figures.—The following are the values given of electrical goods and machinery in the official returns of imports and exports for January:—

	January, 1920.	*Inc. or dec.*
	£	£
Imports.		
Electrical goods, &c.	77,869	+ 1,640
Machinery	1,513,676	+ 218,860
Exports.		
Electrical goods, &c.	690,394	+ 404,049
Machinery	3,733,365	+2,072,458

LIGHTING AND POWER NOTES.

Aberdare. — Year's Working. — The statement of accounts for the year ended March 31st, 1919, gives the total income of the Electricity Department as £8,521, and the total expenditure and allowances as £5,337, leaving a gross profit of £3,184. The net result after deduction of loan interest, &c., was a credit balance of £108.

Barrow.—Water Power.—The Corporation has been asked to appoint a Committee to discuss with a representative of Messrs. Vickers, Ltd., the question of hydro-electric developments in the Duddon Valley.

Belgrade.—Strike.—As a protest against threats made by the Minister of the Interior to intern the leaders of the Communist party, a general one-day strike was declared on February 5th. The city was in darkness, and the tramways suspended by the closing of the power stations.

Blackburn.—Electricity Supply.—Applications from the Rishton and Great Harwood Urban District Councils for supplies of electricity, and also from Preston for a temporary supply, on the completion of the new generating station, have been accepted by the Corporation, subject to satisfactory financial arrangements being made with the Commissioners.

Bolton.—New Plant.—The Minister of Health has sanctioned the borrowing of £44,495 for the provision of four boilers, with accessories, for the Back-o'-th'-Bank generating station.

Bradford.—Plant Extension.—The Corporation is applying for authority to purchase a 5,000-kw. set with steam plant in accordance with the advice of the consulting engineer.

Cannock.—Consultant.—The Urban District Council has decided to engage the services of Mr. Ellis as electrical expert, at a fee of 100 guineas and expenses, to advise the Council on matters relating to the supply of electricity in the area.

Chester.—Joint Board.—A meeting is being held at Chester, this week, when representatives of various districts will discuss the question of formulating a joint-supply scheme for the counties of Cheshire and Flintshire. Queensferry has been suggested as a probable supply centre.

Continental.—Holland.—The consumption of electric power in Amsterdam has increased at such a rate during the last three months that the municipality proposes to extend and enlarge the power stations in 1920. A credit of Fl. 1,900,000 has been applied for.—*Economic Review.*

Spain.—A concession has recently been granted for the establishment of a plant to utilise the water power of the River Douro, near Zamora, for the generation of electrical energy for lighting and power purposes.

Dewsbury.—Extensions.—The Electricity Committee recommends application for power to borrow £8,500 for the purchase of equipment in connection with securing a bulk supply of electricity from the Yorkshire Electric Power Co., and £13,620 for feeder and cable extensions.

Doncaster.—New Plant.—The Town Council has decided to apply for power to install two 3,000-kw. generating sets at the works, which will cost about £120,000.

House Wiring.—The Town Council has applied to the Housing Commissioner for permission to refund £420 on wiring 42 new dwellings for electric lighting.

Dundee.—Electrical Cottage.—To show the advantages of using electricity in a dwelling-house for all purposes—lighting, cooking and motive power—a cottage is to be erected by the Housing and Town Planning Committee.

Farnham.—Price Increase.—The Electric Light Co. has increased its charge for power to 6d. per unit. The pre-war price was 2d.

Fiji.—Suva Supply Scheme.—According to the *Board of Trade Journal*, the Municipal Council of Suva has been authorised to proceed with an electricity supply scheme extending to a distance of three miles beyond the town's boundaries. All the material for the construction of this project is to be admitted to the colony duty free.

Gillingham (Kent).—New Plant.—The Town Council has decided to install at the electricity works two additional Diesel engines, at an estimated cost of between £30,000 and £40,000.

Halifax.—Extensions.—The Town Council proposes to undertake electricity extensions to cost about £170,000. The Electricity Committee, along with the Gas Committee, has appointed a deputation—including one or two persons outside of the Council with special knowledge—to visit towns to obtain information on the best method of utilising gas in connection with the gas and electricity departments.

Hastings.—Proposed Extensions.—The borough electrical engineer has submitted a scheme for a new generating station, which has secured the approval of Sir John Snell. The report prepared was adopted by the Council.

Liverpool.—Extensions.—Building operations on the extension of the Lister Drive power station are to be extended for a further period of 12 months. It is intended to install several new cooling towers. Tenders have been accepted for two batteries of a total capacity of 465,000 gallons per hour, and six steel cooling towers of a total capacity of 750,000 gallons per hour.

Year's Working.—The total revenue from the electricity supply undertaking for the year ended December 31st, 1919, was £629,539, and the total expenditure £416,773, leaving a gross balance of £212,766 allocated as follows:—To interest, £70,452; sinking fund, £60,477; renewals fund, £31,837; and contributed to general rate, £50,000.

London.—Hackney.—The Electricity Committee recommends the expenditure of £66,150 for generating plant and accessories and £105,000 for steam-raising plant and the necessary buildings.

Stepney.—The borough engineer recommends the installation of two 1,500-kw. rotary converters, which, with the necessary foundations, switchgear, &c., will cost approximately £28,600.

Lydd (Kent).—Military Plant.—The Town Council has approached the War Office with a view to acquiring the electric light plant at the Balloon School and utilising it for supplying electricity to the town.

Nelson.—Extensions.—Tenders, amounting to £82,869, have been accepted by the Town Council for extensions of plant at the electricity works. It is stated that the continued running of the station has been endangered by fuel shortage, and at one time only three days' stock remained.

Oldham.—House Lighting.—The Corporation has decided to install electric lighting in the dwellings being constructed under the municipal housing scheme.

Peterborough.—Loan.—The Council is applying for sanction to borrow £4,000 for house services and meters, instead of £2,000, as originally estimated, owing to the increased applications for the supply of electricity.

Sheffield.—Fire.—Serious damage was caused by an outbreak of fire at the Sheaf Street power station, on February 5th. Fortunately, the fire occurred in the morning, but, nevertheless, many business houses were unable to secure a supply for illumination, which was badly needed on account of the foggy weather.

Stockton.—Mains Extensions.—To extend the area of supply to outlying districts, the electrical engineer recommends the laying of E.H.T. mains and L.T. distributors. The scheme involves the erection of a sub-station. The Electricity Commissioners are to be consulted in the matter.

Stoke-on-Trent.—New Station.—The electrical and consulting engineers have advised the Council that a new generating station, to have an ultimate capacity of 30,000 kw., is urgently required. A special meeting of the Council is being called to consider the proposals.

St. Annes.—Extensions.—In order to cope with the increase in consumers, the electrical engineer proposes mains and feeder-cable extensions costing £10,074. The Council is applying for a loan of this amount.

Watford.—Loans.—The Urban District Council has applied for loans amounting to £45,300 for sub-stations, equipment, mains, public lighting, house services, transformers, meters, and feeder panels.

TRAMWAY AND RAILWAY NOTES.

Aberdare.—Year's Working.—The report for the year ended March 31st, 1919, shows that the total income from the tramways and 'buses was £26,758, and expenditure £18,081—a gross profit of £8,677. A net profit of £3,855 was transferred to the appropriation account.

Blackpool.—Expenditure.—January's account approved by the Corporation totals £555,539. Nearly one-half is accounted for by the purchase of the Blackpool and Fleetwood tramroad undertaking, the following items appearing:—Blackpool and Fleetwood Tramroad Co., Ltd., £246,794 5s. 9d; John Cameron, £10,000; Blackpool and Fleetwood Tramroad Co., Ltd. (directors), £4,000.

Bradford.—New Car.—The city tramway manager has introduced a new type of car, with a closed upper deck, for addition to the local trackless car service. The existing vehicles are single deck, accommodating 29 passengers. The new type, for the building of which the Ministry of Transport has given sanction, will carry 51 persons. Only one car is to be built at first, as an experiment, and the construction will be carried out at the Thornbury Works of the Tramways Department. Sanction has also been received to increase the weight of the present railless cars from 5 tons loaded to 5 tons unloaded, so that cars can be built on a more substantial basis, and, therefore, have a longer life.

Ashton-under-Lyne.—FARE INCREASE.—Penny fares have been abolished on the Corporation tramways, and a minimum fare of 1½d. has been instituted on all the principal routes.

Continental.—SPAIN.—Severe street fighting is reported from Santanda (Spain) between the tramway employés on strike and gendarmes. The authorities endeavoured to maintain the tramway services with the aid of volunteers and gendarmerie to clear the routes, but found it necessary to fire on the strikers. The latter fired back, and in the passage of arms four tramwaymen were injured.

Doncaster.—CAR DEPÔT.—It is reported that the lowest tender for a proposed new tramway shed was £7,983, and the borrowing powers extended only to £5,500. The Council authorised the Electricity and Tramways Committee to accept the tender, and further application is to be made for power to borrow the excess.

Dover.—FARE INCREASE.—The Corporation is applying for authority to increase the tramway fares by 50 per cent. The present rate is 1d. per mile.

ADDITIONAL CARS.—The Town Council has received sanction to a loan of £6,000 for the purchase of three new tramcars.

Dublin.—TRAMWAYS PROFITS.—It is announced that the total profit made by the Dublin United Tramways for the year ended December 31st, 1919, was £148,271. A motion put forward, at a meeting of the Corporation last week, to postpone the question of municipalisation for a year, was defeated.

Huddersfield.—OPPOSITION TO BILLS.—The Corporations of Huddersfield and Halifax are "up against" each other with regard to their respective Parliamentary Bills. Halifax is going to oppose the Huddersfield proposal to undertake tramway and motor-'bus extensions which affect the interests of Halifax in some of the townships between the two places; and Huddersfield is to oppose the Halifax proposal to extend tramways to Elland *via* Elland Wood Bottom.

India.—RAILWAY ELECTRIFICATION.—At the meeting of the Imperial Legislative Council, held on September 23rd, 1919, the following resolution, which was moved by the President of the Bengal Chamber, was adopted:—"This Council recommends to the Governor-General in Council the immediate consideration of the electrification of the suburban railways within 25 miles of Calcutta, and of the improvement generally of local passenger transport and terminal facilities."—*Board of Trade Journal.*

Lancashire and Yorkshire Railway.—In the estimate of further expenditure on capital account, the item "electric power stations, &c.," figures at £120,500 for the year ending December, 1920, and £80,200 subsequently. The total train-miles run electrically during 1919 were 1,968,058.

Leeds.—OVERCROWDING.—The medical officer of the West Riding County Council has asked the Corporation to take steps to remedy the present overcrowding of the cars, as he considers it extremely detrimental to the public health.

London.—UNDERGROUND RAILWAYS.—In an interview with a Press representative on Saturday, an official of the Underground Railways gave the following interesting figures illustrative of increased working expenses:—

	1914.	1920.
Coal ... ...per ton	14s. 11¾d.	42s. 5d.
Steel rails ... „	£7	£20 7s. 6d.
Mild steel ... „	£7 2s. 6d.	£25
Bar iron... ... „	£7 15s.	£28
Lubricating oil...per gal.	1s. 5d.	3s. 7d.
Paints ... ...per cwt.	23s. 5d.	50s. 9d.
Cost of an omnibus ...	£550	£1,200
„ „ eight-car train	£17,900	£58,720
„ „ a tramcar ...	£900	£2,500

—*Financial Times.*

ELECTRIC VAN.—The first of the 2-ton electric parcel delivery vans was put in commission last week by the Metropolitan Railway Co. It is fitted with "Ironclad" accumulators with a capacity of 226 ampere-hours. Its average speed is 10 M.P.H., and it can run a distance of from 35 to 40 miles on one charge.

MAXIMUM SPEED.—The London United Tramways Co. is asking the Board of Trade to sanction a maximum speed limit of 16 miles an hour. The Hammersmith Council urges that the limit should be 12 miles an hour.—*The Times.*

ACCIDENT.—On February 5th eight passengers were injured in a collision between a tramcar and motor-omnibus at Vauxhall Cross. The 'bus endeavoured to cross the lines in front of the car, but failed to pass in time.

Manchester.—EXTENSIONS.—It is anticipated that approximately £160,000 will be expended during the financial year 1920-21, upon additional cars and accommodation.

Portsmouth.—FARE INCREASE.—The tramway fares were raised 50 per cent., as from February 5th.

Rochdale.—NEW TRACK.—The Tramways Committee is seeking the consent of the Ministry of Transport to the laying of a double line of track along Bridge Street, from Bury Road corner, to the electricity works, in place of the existing single line.

TELEGRAPH AND TELEPHONE NOTES.

Automatic Telephones.—The Bolton Town Council has appointed a deputation to interview the Postmaster-General, in the hope of securing a reversal of the decision of the authorities to install a new manual telephone equipment rather than an automatic exchange there next year. The automatic system has been refused on the ground that the cost is prohibitive.

Costa Rica.—On December 31st, 1918, there were 122 telegraph offices, 1,514 telephones, and 2,291 miles of telephone wire in operation. Excluding cable and wireless messages, 416,831 telegrams were sent during the year 1917-18, the revenue received being 223,045 colons. The nominal value of the colon is just under 2s.

Germany.—It is stated by the German Minister of Posts and Telegraphs that the working of the postal and telegraph services during 1920 is expected to result in a deficit of 1,250,000,000 marks, and a still further increase in the charges for these services is indispensable.

Pacific Cables.—The report of the Pacific Cable Board for the financial year ended March 31st, 1919, with statement of accounts, shows that the net traffic receipts were £554,511, which exceed those of 1917-18 by £152,537. The increase was the result of war conditions. The expenditure exceeded that of the preceding year by £23,848. During the year over 8,300,000 paying words of international traffic other than local traffic in Australasia and the Pacific were handled. This was over 800,000 words in excess of the total during the previous year, but 439,000 less than the total for 1916-17. Free messages to, from, and in relation to wounded members of the Expeditionary Forces totalled 200,000 words, against 600,000 in the preceding year. In addition to international traffic, 1,830,000 paying words were carried during the year between Australia and New Zealand and between Australasia and the Pacific Islands. Throughout the year there was great congestion, primarily due to the large amount of Government traffic. At times it became a matter of great difficulty to control the acceptance of traffic, and Government Departments and the Press were appealed to with the object of reducing their cabling in the interests of the public. The Board is indebted to the Press for forbearance during these times of pressure.

The cable section between Norfolk Island and Southport became faulty on August 19th, 1918, and repair by the *Iris* was completed on September 5th, 1918. A total interruption of the cable did not take place until the ship cut in, but the fault rendered duplex working impracticable. The breakdown of this cable did not have any serious effect upon traffic as it was possible to circulate *via* Auckland and Sydney all messages which would ordinarily have gone over the Southport cable. During the repair operations the Norfolk Island-Auckland cable was accidentally cut. This led to the discovery of a section in an unsatisfactory condition which would not have been detected but for the accident. The weak spot was cut out and the cable was restored within a few hours. The other cables were maintained without interruption and in excellent condition. The depôts, instruments, and plant generally, have continued in good order.

The *Iris* continues in first-class condition, and in addition to the operations at Norfolk Island, carried out two repairs (April, 1918, and November, 1918) to the Cook Straits cables on behalf of the New Zealand Post and Telegraph Department, and repaired one of the cables between Sydney and Wellington for the Eastern Extension Telegraph Co., in October, 1918.

The landline between Montreal and Bamfield, which the Board leases from the Canadian Pacific Railway Co., worked well during the year under review and suffered few serious interruptions. A further line, between Halifax (Nova Scotia), and Montreal has been leased from the Canadian Pacific Railway for a period of 10 years with liberty to terminate the lease at an earlier date on payment of specified penalties. The Halifax connection is worked by the Board's staff and maintained in good order by the Canadian Pacific Railway Co. The Board has direct connection with the terminus at Halifax of the Imperial Atlantic Cable which is also operated by the Board's staff, the English end being operated by the British Post Office. The landline in Australia, between Sydney and Melbourne, which is operated by the Board's staff, gave very satisfactory service throughout the year.

Radio Research Board.—A Radio Research Board has been established by the Department of Scientific and Industrial Research to co-ordinate and develop researches into wireless telegraphy and telephony at present being undertaken by Government Departments, with the following membership:—Admiral of the Fleet, Sir Henry B. Jackson, F.R.S., chairman; Commander J. S. Salmond, R.N., Lieut.-Col. A. G. T. Cusins, Wing-Commander A. D. Warrington Morris, Mr. E. H. Shaughnessy, and Prof. J. E. Petavel, F.R.S., representing the Admiralty, War Office, Air Ministry, Post Office, and Department of Scientific and Industrial Research respectively; and Prof. Sir Ernest Rutherford, F.R.S.

The Hague.—A new telephone exchange on the semi-automatic system has just been opened at Scheveningen, after over five years' delay. It had been intended to complete the exchange in 1914, when the plant and equipment—supplied by the Western Electric Co.—were lying at Antwerp, but these were seized by the Germans on the occupation of this port and scattered broadcast.

South Africa.—The number of telegraph offices increased during 1918 from 1,703 to 1,738, and the number of messages from 6,174,888 to 6,619,635.

The Telegraph Service.—It is estimated that at the Central Telegraph Office alone the daily number of telegrams dealt with usually ranges between 120,000 and 165,000, the highest total being 355,353 on the occasion of the railway strike, on September 29th, 1919. The total number of telegrams handled is close upon 90 millions. The number of telegraph offices in the United Kingdom in now approximately 14,000, and the record number of words transmitted in one day is 1,885,400 words, on December 5th, 1910.

United States.—A severe snowstorm, accompanied by a north-east gale, did much damage, last week, in the entire eastern part of the States, and both telegraphic and telephonic communication was interrupted.

Wireless Telephony.—It is reported in the daily Press that experiments in wireless telephony across the Atlantic between Britain and the U.S.A. are now being carried out.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Aberdare.—Urban District Council. Electricity and Tramways Department. Stores for 12 months, including cables, meters, joint boxes, electric lamps, &c. (February 6th.)

Aldershot.—February 17th. Urban District Council. Electricity Department. Geared turbine and generator, condensing plant, pumps, water-tube boiler and superheater, cables, &c. (January 23rd.)

Australia.—MELBOURNE.—March 30th. City Council. 12,000 metal filament incandescent lamps. (February 6th.)

April 12th. City Council. Two 2,000-KW. rotary converters; H.T. switchgear, 6,600 V.; D.C. switchgear, 600 V. (January 30th.)

Bedford.—February 21st. Electricity Department. E.H.T. cable and transformers, E.H.T. switchgear. (February 6th.)

Belfast.—February 14th. Tramways Committee. Tramway stores, including electrical accessories, cable, lamps, carbon brushes, trolley wire, &c. (January 23rd.)

Belgium.—February 27th. Municipal authorities of Villers-le-Peuplier (Province of Liege) are inviting tenders for the concession for the supply of electrical energy for lighting and power purposes in the district.

February 16th. La Société Nationale des Chemins de Fer Vicinaux, Brussels (48, Rue Montoyer). Supply of 15,000 kg. of copper wire, 4 m/m. dia., in connection with the telephone installation.

Bedwas (Mon.).—March 4th. Bedwas Navigation Colliery Co., Ltd. Six months' supply of stores, including electrical goods, &c. (February 6th.)

Bristol.—February 23rd. Electricity Department. One 2,000-KW., single-phase, 2,200-V. turbo-generator, complete with condenser and auxiliaries. (February 6th.)

Chester-le-Street (Co. Durham).—March 3rd. Urban District Council. Underground mains and all equipment for lighting district by electricity. F. J. Gray, Clerk, Council Offices.

Easington.—Rural District Council. Extension of Easington parish electric lighting. Specification, &c., from Mr. E. N. Simpson, Brampton House, Easington, Co. Durham.

Farnworth.—February 25th. Urban District Council. One 750-KW. rotary converter, transformer, switchgear and instruments, cables, &c. (See this issue.)

Hammersmith.—March 3rd. Electricity Committee. Stores for 12 months, including electric light sundries, insulated wire, meters, jointing compound, &c. (See this issue.)

Kings Lynn.—February 20th. Electricity Department. One Lancashire boiler, superheater, piping, &c. (January 30th.)

Lincoln.—March 2nd. Electricity Department. One automatic battery, for St. Swithin's Power Station. (February 6th.)

London.—H.M. Office of Works. February 13th. Supply of electric cable and wire during period ending December 31st, 1920. (February 6th.)

CAMBERWELL.—St. Giles' Board of Guardians. Three 5-H.P. and 15-H.P. A.C. motors, and one fan. (February 6th.)

Madagascar.—TAMATAVE.—March 1st. Paris, Ministère des Colonies (Service Administratif Colonial). Construction of water and electric supply services in the City of Tamatave, including development of the Volobefalls, and supply of electric machinery, &c.

Manchester.—February 17th. Tramways Committee. (*a*) Steel girder tramway rails; (*b*) tramcar trucks; (*c*) controllers for tramcars. Mr. J. M. McElroy, General Manager.

February 21st. Corporation Waterworks Committee. Water turbine, dynamo and switchboard, &c.; storage battery, reversible booster, motor generator, switchboard, D.C. motors, starting panels, &c.; L.T. paper-insulated lead-covered cables. (February 6th.)

February 25th. Electricity Committee. Three three-wire balancers, and the necessary switchgear, for Dickinson Street generating station. Mr. F. G. Hughes, secretary, Electricity Department.

New Zealand.—DUNEDIN.—April 26th. The Imperial Trade Correspondent at Dunedin has forwarded a copy of the specifications and plans in connection with a call for tenders by the Dunedin City Council for (*a*) electric car bodies; (*b*) car trucks; and (*c*) car equipment. These documents may be consulted by British firms interested, at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, S.W. 1 (Room 49). Copies of the specifications and plans can be obtained from the Town Clerk, Dunedin, on payment of a fee of £1 (returnable as usual).

Plymouth.—February 16th. Corporation Transport Department. 20 motor chassis, 20 enclosed omnibus bodies, 11 double-deck tramcars, 100 tons steel rails, six tons fish plates, one motor generator set, one 5 cwt. power hammer. (February 6th.)

Salford.—February 23rd. Electricity Department. Two water-tube boilers, with stokers, mechanical-draught plant, &c. (See this issue.)

Spain.—The municipal authorities of Cambados have lately invited tenders for the concession for the electric lighting of the town.

Uruguay.—February 27th. General Administration of the Electric Power Station of the State. 97,500 electric metal-filament lamps. The Management, Calle Julio Herreva y Obes, 1,458, Montividco.—*Board of Trade Journal.*

CLOSED.

Bolton.—The Electricity Committee has accepted the following tenders:—

Condensing plant for a 12,000-KW. generating unit at Back-o'-th'-Bank.—Hick, Hargreaves & Co., Ltd.

Four sets of economisers at Back-o'-th'-Bank.—E. Green & Son, Ltd.

Burnley.—Town Council. Accepted:—

Five electrical equipments for tramcars, £4,016.—British Thomson-Houston Co., Ltd.

Five single-deck bodies for tramcars, £6,750.—English Electric Co., Ltd.

Cavan.—Electric Light & Power Co., Ltd. Accepted:—

Suction gas engines and plant.—Campbell Gas Engine Co.

Generators and booster.—Electric Construction Co.

Battery.—D.P. Battery Co.

Switchboard.—Hurst Electric Plant, Ltd.

Doncaster.—Town Council:—

Raising the level of part of the Bentley tram track, £2,790.—Edwards and Co.

Hammersmith.—Borough Council. Electricity Committee. Recommended. Refractory bricks and blocks, ground fireclay, &c.:—

Sections A and B, £652.—Hill, Westlake & Co.

Section C, £213.—Metallurgical Plant Construction Co., Ltd.

Section D, £114.—J. H. Sankey & Son.

Mains extension; supply of 250 yd., each '1 sq. in., '2 sq. in., '3 sq. in., and 500 yd. '15 sq. in.:—

	£	Delivery.
Union Cable Co., Ltd., (recom.)	**1,800** ..	**6/7 weeks**
B. I. & Helsby Cables, Ltd.	1,880 ..	10 ,,
Western Electric Co., Ltd.	1,849 ..	8 ,,
Callender's Cable & Construction Co., Ltd.	1,869 ..	12 ,,
Siemens Bros. & Co., Ltd.	1,898 ..	8 ,,
W. T. Glover & Co., Ltd.	1,898 ..	12/14 ,,
Enfield Ediswan Cables	1,905 ..	8 ,,
Johnson & Phillips, Ltd., ...	1,912 ..	12 ,,
Pirelli Cable Co., Ltd...	1,986 ..	12/14 ,,
Macintosh Cable Co., Ltd.	2,027 ..	10/14 ,,

1,000-yd., each 3-in. single and 3-in. two-way cable ducts:—

Sutton & Co., ...	£410
Doulton & Co., Ltd.	412
T. Wragg & Son (recom.)	**420***
Albion Clay Co.	490
General Electric Co., Ltd.	504
Sankey & Co.	524

(*Two-way, 3½ in., same price as 3 in., including delivery on site.)

Tenders received for the work of linking-up the stations of Fulham and Hammersmith:—

	Scheme A.	Scheme B.	Scheme C.
	£	£	£
Pirelli-General Cable Works, Ltd.	18,330	18,400	19,150
Western Electric Co., Ltd.	15,100	15,150	16,364
B. I. & Helsby Cables, Ltd.	16,125	16,045	16,445
Callender's Cable & Constrn. Co., Ltd. ..	17,231	18,344	18,448
W. T. Henley's Tel. Works Co., Ltd. (recom.)	**15,658**	**15,695**	**15,905**
Siemens Bros., Ltd..	16,402	16,527	16,755
Union Cable Co., Ltd.	16,864	16,970	17,070
Johnson & Phillips, Ltd.	16,210	16,226	18,463
Macintosh Cable Co., Ltd..	15,791	16,110	16,561
W. T. Glover, Ltd.	16,666	16,716	—

London.—STEPNEY.—Electricity Supply Committee. Feeder cable (Limehouse generating station and Whitechapel sub-station) :—

Henley's Teleg. Works Co., Ltd. (recom.)	£7,329*
B. I. & Helsby Cables, Ltd.	7,488*
W. T. Glover & Co., Ltd.	8,092*

*Subject to market fluctuations and based on copper at £123 and lead at £18 10s., but cannot guarantee delivery under penalty.

ST. MARYLEBONE.—Electric Supply Committee. Recommended. Water-cooling tower, capacity 412,000 gallons per hour :—

Film Cooling Tower, Ltd.	£4,490
Clyne Engineering Co., Ltd. (recom.)	9,575
Davenport Engineering Co., Ltd.	14,832

Rotary strainer for canal water, £945.—London Elec. Supply Corptn., Ltd.

Three-motor overhead travelling crane (60 ton) :—

Babcock & Wilcox, Ltd.	£5,725
Higginbottom & Mannock, Ltd.	4,970
H. Morris, Ltd. (recom.)	4,815

Torquay.—Town Council :—

Two 2-ton electrically-driven lorries.—Edison Accumulator Co., Ltd., £1,372 each.

FORTHCOMING EVENTS.

Salford Technical and Engineering Association.—Saturday, February 14th. At the Royal Technical Institute. At 7 p.m. Paper on "Liquid Air," by Mr. J. L. Duckworth.

Association of Engineers-in-Charge.—Saturday, February 14th. At St. Bride's Institute, E.C. At 7.30 p.m. Social and dance.

Royal Institution of Great Britain.—Saturday, February 14th. At Albemarle Street, W. At 3 p.m. Lecture on "The Astronomical Evidence Bearing on Einstein's Theory of Gravitation," by Sir F. Dyson, F.R.S.

Tuesday, February 17th. At 3 p.m. Lecture on "Magnetic Susceptibility," by Prof. E. Wilson.

Friday, February 20th. At 9 p.m. Lecture on "British Crop Production," by Dr. E. J. Russell, F.R.S.

Battl Wallahs' Society.—Monday, February 16th. At the Holborn Restaurant. At 1 p.m. Lecture on "Electricity in Warfare," by Major T. Rich, R.E.

Institution of Electrical Engineers.—Monday, February 16th. Informal meeting. At the Institute of Patent Agents, Staple Inn Buildings. At 7 p.m. Lecture on "Automatic Telephony for Private Branch Exchanges," by Mr. A. B. Eason.

(**Wireless Sectional Meeting**).—Wednesday, February 18th. At the Institution of Civil Engineers, Gt. George Street, S.W. Paper on "Wireless Telephony on Aeroplanes," by Major C. E. Prince.

(**Students' Meeting**).—Friday, February 20th. At Faraday House. At 7 p.m. Discussion on "State Ownership *versus* Private Enterprise," to be opened by Mr. A. Serner.

Saturday, February 14th. At 2 p.m. Visit to Chingford Pumping Station of Metropolitan Water Board.

Association of Engineering and Shipbuilding Draughtsmen.—Lectures will be given at Liverpool on February 17th and 18th; Manchester, February 19th; and at Glasgow, Barrow-in-Furness and Sheffield, on February 20th.

Belfast Association of Engineers.—Thursday, February 19th. At the Municipal Technical Institute. At 7.45 p.m. Paper on "The Ultimate Constitution of Matter," by Mr. W. C. Ward.

Electrical Power Engineers' Association (Manchester District Section).—Thursday, February 19th. At the Milton Hall, Deansgate. At 7 p.m. Address by the ex-President.

Junior Institution of Engineers.—Friday, February 20th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 7.30 p.m. Paper on "Obscure Points in the Theory of the Internal-combustion Engine," by Prof. F. W. Burstall.

Institution of Mechanical Engineers—Friday, February 20th. At the Institution, Storey's Gate, S.W. At 6 p.m. Annual general meeting and resumed discussion on Mr. E. M. Bergstrom's paper on "Recent Advances in Utilisation of Water Power."

"Daily Mail" Ideal Home Exhibition at Olympia.—Open until February 28th.

Royal Society of Arts.—Wednesday, February 18th. At John Street, Adelphi, W.C. At 4.30 p.m. Paper on "English Canals and Inland Waterways," by Mr. S. Preston.

Chemical Society.—Thursday, February 19th. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary scientific meeting.

NOTES.

Fatality.—At an inquest at Redcar, on February 4th, on S. G. Mackenzie, cabin boy and electric pump attendant, of Middlesbrough, who was killed at the Warrenby Ironworks, it was stated that the lad was found lying on a live wire. An electrician, named Elisha Price, stated that he did some repairs to the apparatus driving the electric pump. He connected up the switch box. When he left it, the pump was working all right, and, as far as he was aware, everything was covered up in the proper manner. Questioned, witness stated he did not know there was an earth wire attached to the switch box for safety. It was part of his duty to see that such wires were connected, but these were generally fitted when the plant was installed, and he took it for granted it would be so in this case. W. R. Davidson, chief electrician, said that he found, after the accident, that the switch was not earthed. The apparatus had been worked from another switch, and the one connected by Price was not intended to be used. In returning a verdict of "Accidental death through being electrocuted," the Coroner said there was evidence of a certain amount of neglect on the part of Price, who ought to have made a closer inspection of the apparatus, and also on the part of the foreman, who ought to have earthed the switch when the apparatus was installed. It was stated this was the first accident of the kind the firm had had during its 25 years' experience of electrical plant

Educational.—The Council of Liverpool University has appointed Mr. G. R. Scholes, M.Sc., M.B.E., to the recently established Chair of Engineering—Thermodynamics of Heat Engines.

ENGINEERING APPEAL FUND.—OVER £20,000 ALREADY RAISED.—In response to the appeal recently issued for the sum of £100,000 for the reconstruction and re-equipment of the Engineering Buildings at University College, London, the following sums have already been received :—£250, Siemens Bros. & Co., Ltd.; £105, Redpath, Brown and Co., Ltd.; £100 each, Lazard Bros. & Co., Ltd., C. H. Merz, Esq., Sturtevant Engineering Co., Ltd., and Wallsend Slipway and Engineering Co., Ltd.; £52 10s., Bullevant & Co., Ltd. These sums, together with smaller amounts, bring the total of the fund to £21,545, apart from the additional £10,000 promised by Lord Cowdray, provided the total subscriptions reach £70,000. Further subscriptions to the fund may be sent either to Prince Arthur of Connaught at 42, Upper Grosvenor Street, W., or to Sir Ernest Moir, Bart., at University College, London.

Federation of Staff Workers.—On Saturday last, the inaugural meeting of the "National Federation of Professional, Technical, Administrative, and Supervisory Workers" was held in London. Mr. G. D. H. Cole, of the Labour Research Department, who presided, stated that the scheme had no connection with the Labour Party or the Trade Union Congress, and that membership would not necessarily involve membership of the Congress. A resolution was passed *nem. con.* approving of the formation of the Federation, and a Provisional Council was elected, consisting of delegates from the Associations represented at the meeting, to hold office until a further conference is held to inaugurate the Federation. Each Society is to pay an entrance fee of £30. The objects of the Federation were explained in our last issue.

Mr. Norman Wyld, general secretary of the Society of Technical Engineers, made statements to the Press and wrote a letter to *The Times* with regard to the position of his Society. A representative of that Society moved an amendment to the effect that "a Federation be formed of professional associations, independent of employers' unions on the one hand and manual workers' unions on the other, and free to negotiate with both in the best interests of the professional worker." Several other Societies' representatives supported the motion, but it was not carried. The purpose of the motion was to make it clear that membership of the Federation would not involve close alliance with the manual workers, and the fact that it was rejected made it evident, in his opinion and that of his friends, that the meeting desired to associate itself with either the employers or the manual workers. They had no desire to oppose the formation of the Federation, and, therefore, did not vote against the resolution, but they were proceeding with the formation of "a federation of four federations of professional workers." In his letter to *The Times*, Mr. Wyld explained that the latter movement had made great progress, and that a constitution for the confederation was being drafted. Pending the formation of the confederation, his Society had decided to avoid alliance with either the workers or the employers.

Non-Ferrous Materials.—The following particulars are published of the stocks (exclusive of old metal and scrap) in this country of soft pig lead and refined spelter in the possession of the Minister of Munitions on February 1st, 1920 :—

Soft pig lead	47,348 tons
Refined spelter	8,697 ,,

N.B.—It must be noted that a proportion of the above stocks is already sold to the trade for forward delivery.

Since the stocks of virgin non-ferrous metals unsold under the control of the Government have now reached such proportions that they cease to be an important factor in the general stocks of such metals held in the United Kingdom (with the possible exception of lead and refined spelter), it is proposed to discontinue publication of these notices in the near future.

Flue Gas in Oil Combustion.—An error in interpreting the CO_2 content in flue gas, when burning oil, is likely to arise among engineers who have been familiar with coal burning. This comes from the fact that perfect combustion of coal would give a higher CO_2 reading than perfect combustion of oil. Comparing particular samples, oil could not possibly give a higher CO_2 reading than 15·6 per cent., while the coal, theoretically, might give 18·8 per cent. The explanation of this lies in the greater amount of hydrogen in the oil. The hydrogen requires oxygen for its combustion, and this in turn brings in nitrogen, which appears in the flue gas. The hydrogen does not produce CO_2, and the water-vapour that it does produce does not appear in the flue-gas analysis. The result is that the higher the hydrogen content in the fuel the lower is the theoretical CO_2 percentage in the flue gas.—*Power.*

The Channel Tunnel.—The Channel Tunnel Parliamentary Committee, in a *résumé* of the recent history of the project, states that it is uncertain when the Cabinet will arrive at a decision, but it is clear that the Bill for the construction of the tunnel cannot be passed in the forthcoming session unless it receives the wholehearted support of the Government. Failing that condition, the commencement of this work must be delayed for another year.

Welded Ships.—An electrically-welded vessel was launched on February 5th, at Birkenhead, from the Cammell Laird yard. The ship is a coasting vessel 150 ft. long, and designed to carry nearly 500 tons of cargo. The experiment has been followed with great interest; this is the second electrically-welded vessel to be completed in this country. The Quasi-Arc system was used.

Summer-Time.—The Belgian Minister of the Interior has fixed the night of March 14-15th for the commencement of summer-time. The clocks will be put forward an hour. The French Senate has adopted a Bill introducing summer-time from Saturday evening, February 14th. The lack of co-ordination is very regrettable; it is sure to result in much confusion in international relations.

The Electricity Commissioners.—The following paragraph appeared in *Electrical Industries* of February 11th:—

"Sir John Snell, Mr. Harry Booth (of the Board of Trade), and Mr. Archibald Page, M.I.E.E., general manager of the Clyde Valley Electrical Power Co., have been appointed Electricity Commissioners. The two remaining appointments have not yet been announced, but we understand that the posts will be filled by a leading municipal engineer and by an official with wide experience of administrative work on a London municipal authority."

On inquiry of the Ministry of Transport, we have not been able to obtain either confirmation or denial of the statement. Our Glasgow correspondent sends us the announcement of the appointment of Mr. Page, and of his successor at the Clyde Valley Power Co. (see "Personal" column).

The Electrical Wholesalers' Federation.—This Federation held its annual meeting at the Hotel Russell, London, on Wednesday.

Our Lead Supplies.—Just as we go to press, we have received the following letter:—

"The Board of Trade returns for January, issued this week, afford ample confirmation of the article on the above subject in your last week's issue.

"The figures given for 1919 show 189,114 tons for absorption in the United Kingdom for the year, or an average of 15,759 tons per month.

"The imports for January amounted to 5,888 tons, the exports to 4,679 tons, the balance left being only 1,209 tons.

"May we put it more forcibly by giving the figures for the last three months:—

	Nov.	Dec.	Jan.		
"Imports ...	2,679	12,496	5,888	=	21,063
"Exports ...	5,874	6,393	4,679	=	16,946
"Left for United Kingdom absorption ...					4,117

"We have then the astounding position that for the three months which, on the average of last year, should show 47,277 tons for home consumption, we have actually received 4,117 tons.

"These figures should dispose of such reports as those asserting that there is no danger of short supplies.

"The Government stock is now practically sold out, and the deliveries from this source alone have hidden the real position which is now being disclosed.

"THE WRITER OF THE ARTICLE."

"February 11th, 1920.

Appointments Vacant.—Telegraph inspectors (£200 + £65), for the Posts and Telegraphs Department in German East Africa; assistant engineer (£350), for the Hackney Borough Council Electricity Supply Department; foremen and instructors in armature winding, meter repair, contracting (lighting dynamo and motors) and fitting for the Government Instructional Factory, Hackney Wick; whole-time teacher in electrical engineering and physics (£225 to £315), for the London County Council School of Engineering and Navigation, Poplar; shift engineer (£264), for the Accrington Corporation Electrical Engineering Department; head of the Heat Treatment Laboratory, for the Loughborough Technical College; overhead linesman, for the Rawtenstall Corporation Tramways; two meter testers (£208), for the Bradford City Electricity Supply; charge engineer (£270), for the Bootle Corporation Electricity Works; junior staff engineers and control-room attendants, for the Rotherham Borough Council Electricity Supply Department; engineer chief assistant, for Edmundson's Electricity Works, Inverness; meter tester and installation engineer (£260), for the Walsall Corporation Electricity Supply Department; draughtsman (£300), chief clerk (£250), for the Doncaster Borough Council Electricity Department. See our advertisement pages to-day.

Danish Patent Law.—In the *Illustrated Official Journal (Patents)* of February 4th attention is called to the provisions of the Danish Law, amending the Law of Patents, which was passed on December 22nd, 1919. This law empowers the Minister of Commerce, upon terms to be fixed by him, to restore patents which have been cancelled since August 1st, 1914, by reason of non-payment of fees, or for non-working; to extend the term of a patent by a period not exceeding five years when the patentee has been prevented by the war from exercising his rights; and to reconsider any application the consideration of which was suspended between August 1st, 1914, and the end of 1919, owing to official communications remaining unanswered. The benefits of this law may, subject to reciprocity, be extended by Royal Decree to subjects of other countries. A copy of a translation of the law may be inspected in the Patent Office Library.

Restoration of Lens Mines.—Only a part of Lens mines has been cleared so far, and, allowing for regular work, it will take the whole of 1920 to clear them entirely. Twelve pits are already cleared at the surface, four are in course of clearance, five are still in a state of chaos. A scheme for electric pumping has been established, the power to be provided by the Société Electrique des Houillères du Pas-de-Calais, which, while waiting for the erection of the proposed 24,000-KW. power station at Hénin-Liétard, will obtain current from the Compagnie de Béthune. German gangs will be entrusted with the repropping of the pits, all the necessary cement being furnished by Germany. As the pumping may take two or three years, the output cannot be resumed, even feebly, before 1923 or 1924. The railway lines cannot be made good before 1921. It must not be reckoned that Lens will be restored before 1928 or 1929.—*Economic Review.*

The U.S. S. "Tennessee."—When the U.S. battleship *Tennessee* was launched at the Brooklyn Navy Yard one of the most formidable machines of its kind in existence was set in motion. Her overall length is 624 ft.; beam 97 ft.; draught 31 ft.; and full load displacement 33,000 tons. She will mount twelve 14-in. guns of 50 calibre, 22 5-in. guns of 51 calibre; two 3-in. anti-aircraft guns; four saluting pieces; and two 21-in. submerged torpedo tubes. Her complement will be 1,119 officers and men. She will be propelled by electricity, supplied by two turbine-driven generators, and each of her four propellers will be driven by its own motor. Her maximum power will be 33,500 H.P., and her maximum speed over 21 knots per hour. The turbines are of the Westinghouse single-cylinder, semi-double flow, impulse-reaction type. The H.P. steam first passes through a two-row impulse wheel in each turbine, and then through a section blading. It then divides into two equal parts and each part passes through a L.P. reaction section into the condensers. The speed of the turbines can be varied through a range of from 1,500 to 2,270 R.P.M., by means of manually-controlled hydraulically-operated governors. The speed of the turbines, as determined by the setting of the governor, remains practically constant, regardless of the load, and hence the propellers do not race when they leave the water in rough weather. Automatic stops are also provided, which cut off the steam in case the speed of the turbines exceeds a safe value. The generators direct connected to the turbines, are two-pole Westinghouse machines, and supply the motors with 3-phase, 3,400-volt A.C. at frequencies ranging from 25 to 38 cycles, depending on the turbine speed. They are excited from the D.C. power supply of the ship, and each can develop 15,000 K.V.A. at the maximum speed of the turbine. The generator coils are very carefully insulated so as to prevent injury from high temperature, moisture, and accumulations of salt. They are kept cool by air which is forced through the ventilating ducts by fans mounted on the rotor shafts. The four motors are of the Westinghouse induction type, direct-connected to the propellers, and each can develop a maximum of 8,375 H.P. continuously. To provide a sufficiently wide speed range, each has two windings, one of 24 poles and the other of 36 poles. The 24-pole winding is connected to slip-rings on the rotor shaft, while the 36-pole winding has short-circuiting connections and is equivalent to a squirrel-cage arrangement. Both windings are used for running, but only the 24-pole for starting and reversing, resistance being inserted in series with it during these operations. The insulation of the motor is similar to that of the generators, and ventilation is provided by means of two motor-driven fans mounted on the top of each motor. The 36-pole winding is equivalent to a gear of an 18 to 1 ratio between the turbines and the propeller, while the 24-pole winding is equivalent to a gear of a 12 to 1 ratio. From 9 to 15 knots, the motors are operated on the 36-pole windings, and all four are driven by one turbo-generator. From 17 to 21 knots, the motors are operated on the 24-pole windings by means of one turbo-generator. From 17 to 21 knots, the motors are operated on the 24-pole windings, by means of both turbo-generators. To reverse, two phases at each motor are transposed without changing the direction of rotation of the turbo-generators. The use of one turbo-generator for the lower speeds assists in maintaining good operating economy by keeping the load on the unit close to its rated capacity except at the very slowest speeds. The steam consumption per shaft H.P.-hour, including that required for excitation, condenser operation, and motor ventilation, is as follows:—

Speed in knots.	Motor-poles.	No. turbo units.	Lb. of steam.
9	36	1	16
15	36	1	12
15	24	1	13
17	24	1	13
17	24	2	12.4
19½	24	2	11.7
21	24	2	11.9

All the switching apparatus for controlling and distributing the power is located in a control room. The rheostats used for starting and reversing the propeller motors are of the automatic liquid type. In order to ensure the best possible type of construction, a committee of the American Institute of Electrical Engineers assisted the Navy Department in preparing the specifications for the cables. The main circulating pumps are of the centrifugal type operated by 235-H.P. motors. Their speed can be varied so that power consumption can be reduced with the speed of the ship. Le Blanc air ejectors, which are novel on this class of ship, maintain a high vacuum in the condensers. The condensate is handled by motor-driven vertical centrifugal pumps. Thus all the main engine room auxiliaries are rotary and are motor-driven.—*Electrical News.*

Mechanical Stokers.—Erith's Engineering Co., Ltd., is furnishing to the orders of Edinburgh Corporation Erith-Riley stokers, which are much larger than any stokers hitherto made in any country; each stoker being no less than 33 ft. wide, and it is also furnishing identical stokers to Shanghai electricity works, each stoker being assembled from standardised uniform self-cleaning retort-units, set side by side in a straight-walled furnace, under water-tube boilers normally evaporating 80,000 lb. high-pressure superheated steam hourly. The coal is fed, the fires are sliced, and the incombustible ash is continuously discharged without manual labour. The labour-saving, as contrasted with a battery of twelve Lancashire boilers, which needs eight firemen per shift for the identical steaming duty, is self-evident, and the fully automatic Erith-Riley stoker with the modern water-tube boiler gives a thermal efficiency representing a substantial fuel saving, as well as the capacity to use low-grade small fuels to the best advantage. The latest Erith-Riley stokers for Hull Corporation electricity works are exactly similar; but instead of being applied to one 80,000 lb. boiler each, they are applied to a pair of 40,000 lb. boilers, divided only by a partition wall, but allowing only half the capacity to be shut down at a time, while giving identical results, just as is the case with the stokers of similar capacity at the Bow power plant of the Charing Cross Electric Supply Co., London, where the large boilers are set in pairs, but back to back. The stokers as above are each six times as large as the first ones built in 1914.

Single-shaft Curtis Turbines.—The present limits of speed and power of single-shaft Curtis steam turbines are discussed in three papers published in the *Proceedings* of the A.I.E.E. for November. Mr. Eskil Berg's paper starts by showing that the limit of a single-unit turbo generator does not lie in the generator but is confined to the steam turbine, and that the last wheel of the turbine is the limiting feature. The author, therefore, takes the last wheel of an 1,800-R.P.M. turbine, giving dimensions, stresses, kind of material used, &c., and then designs two turbines, one having 23 stages and the other 13 stages, both machines using this last wheel, and shows that a turbine can be built having its most economical point at 21,000 KW., under steam conditions given in the paper. Under this condition the last stage absorbs 11.5 per cent. of the total adiabatic available energy, and the wheel efficiency is 66.25 per cent. As the load increases, the work done in this stage also increases, so that at 36,000 KW. the energy is practically doubled, but with a sacrifice in efficiency of about 18 per cent., which naturally lowers the efficiency of the turbine as a whole. A 5,000-KW., five-stage, 3,600-R.P.M. turbine load curve is also given and discussed, and the author claims that if the

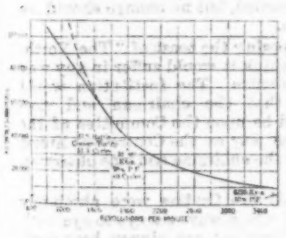


FIG. 1.

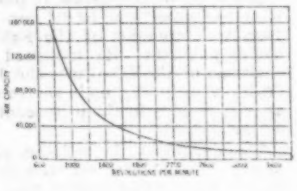


FIG. 2.

MAXIMUM CAPACITY AT VARIOUS SPEEDS OF SINGLE-SHAFT TURBINES.

construction could be made similar to the large turbine, keeping the same stresses and number of stages, a turbine of this capacity could be built as efficient as the larger machine at 20,000 KW.

Mr. F. D. Newbury explains that output is determined broadly by rotor or stator dimensions. With speeds of 1,200 R.P.M. and lower, the stator is the limiting member, while with higher speeds, the rotor is the limiting member. The most effective rotor diameter is not necessarily the largest diameter. To obtain maximum output at a given speed the rotor proportions must be chosen to properly balance mechanical stresses, rotor ampere turns and flux. American design practise has established 400 ft. per sec. as an upper limit of rotor peripheral speed. The maximum length of core is determined by such factors as ventilation, bearing temperatures, critical speed and limits to weight imposed by forging and transportation facilities. The author shows (fig. 1) present limits to K.V.A. rating at speeds from 3,600 to 900 R.P.M. These limiting values are given as indicating present boundaries to knowledge and experience, rather than as real physical or other limits that cannot be exceeded. Mechanical forces due to short-circuit current, and damage caused by armature winding failures, are no greater in the very large generators indicated by fig. 1 than in present day 20,000 and 30,000 K.V.A. units. No opinion is expressed as to the wisdom of installing very large single-shaft units. If operating engineers desire units of 50,000 to 100,000 KW., there is no question but that such generators can be conservatively designed and constructed.

Mr. J. F. Johnson's paper is restricted to a discussion of some factors which influence limits as applying particularly to turbines of the reaction type. With the employment of high vacua the limit of power will be determined largely by the area obtainable through the last stage. Limiting factors include:—1. Chosen maximum values of steam speed through the blades in order to keep the leaving losses within permissible limits. For highest efficiency the steam speed should be about 25 per cent. greater than the blade speed, but in the last stages it is sometimes made 100 per cent. greater as a compromise between efficiency and cost. Similarly the outlet angle of the blades is increased from 20 deg. to 35 deg. 2. Physical characteristics of materials employed and chosen limits to which these may be safely stressed. By varying the form of rotor construction stresses in it may usually be kept within necessary limits up to the point at which limiting stresses in the blades or blade fastenings are reached. For any given rotative speed and blade angle the steam capacity is directly proportional to the stress at the base of the blades regardless of the diameter and blade height. 3. Capacity limits of manufacturing facilities, increased bracing and clearances necessary to ensure requisite rigidity and reliability, and capacity loss due to outages for inspection and repair. Fig. 2 shows maximum capacity at various speeds which are physically possible without exceeding present limits of stresses. It is valuable chiefly as showing the physical relation between speed and capacity with given limiting stress values.

American Electrical Company insures all its Employés.—The General Electric Co. (U.S.A.) has announced a group life insurance plan for all of its employés, including those on G.E. plants and district offices throughout the States. Every employé who has been with the company one year or more will have a substantial amount of life insurance without cost to himself. This applies to everyone in the employ of the company, regardless of age, sex or physical condition. This insurance plan will in a measure relieve the minds of employés as to the danger of financial distress in their families in case of death. Officials of the company have long recognised the value of continuous service, and it is hoped that the plan will encourage permanency of employment. The amount of this insurance is $500 for one year's service, $750 for two years' service, $1,000 for three years' service, $1,250 for four years' service, and $1,500 for five years' service; this is the maximum policy. The life insurance company with whom the policies have been placed requires no physical examination of the employé as a condition of such insurance, which is provided at the company's expense and became effective on January 1st, 1920. The insurance runs for a period of one year, but it is hoped that experience will justify its continuance thereafter. Upon the lives of employés who die leaving no dependents, the amount of insurance is $150, to cover funeral expenses. The insurance ceases as to any employé with the termination of his employment, but the insuring company agrees that insurance on a standard policy form at regular rates may be secured without physical examination upon application to it by the person whose employment is terminated. The General Electric has 23,000 employés in the Schenectady works, where more than 10,000 employés have worked for the company five years or more and a great majority of the remaining 13,000 have served over three years. There are quite a few employés in that and in other plants, however, who have not completed a year's service. These will automatically come within the scope of the plan as soon as they have been with the company a year.—*Electrical Review*, Chicago.

Hydro-electric Power Possibilities.—In an address given by Sir Adam Beck, chairman of the Ontario Hydro-Electric Commission, before the Inland Waterways Convention, recently held at Windsor, Ont., the immense possibilities in the use of water power were emphasised. The speaker took, one by one, various points upon the St. Lawrence and the Great Lakes, giving in each case the possible H.P. development attending the deepening of the river, &c., at those places. The immediate objective was to develop two and a half million H.P., but the total available power for development in Ontario was five millions. Sir Adam Beck calculated that this would mean an annual saving of 100,000,000 tons of coal.

When hydroelectric power was first introduced it was thought that it would be difficult to market 10,000 H.P., but so great has been the development that in nine years the figure has reached 365,000, and the speaker predicted that it would not be long before the whole of the 2,500,000 H.P. of the proposed development would be in use. The estimated cost of the whole of the scheme would be about $100,000,000. The building of the Morrisburg dam would make possible the control of the levels of Lake Ontario with a regulation of from two to four feet. The depth of Montreal Harbour would also be increased by this dam, and its accommodation therefore extended to larger vessels. The levels of Lake Erie would be increased by remedial works from two to three feet, and 50,000 second-feet would be gained without impairing the scenic beauty of Niagara Falls. On the American side 20,000 second-feet would be gained. It had been stated by the scheme's opponents that the war industries which were provided with hydro-power to the deprivation of other industries, would be unused in peace, but facts had proved otherwise, and those industries were now employing just as much power in the manufacture of the commodities of peace.

Concealed Lighting in a Church.—The appropriate lighting of churches is a difficult matter. Conditions and requirements are so various that it is impossible to evolve any generally applicable rules. The degree of illumination, the employment of visible or concealed units, and, if visible, the design of fitting to be used all depend upon three factors, viz., the interior architecture of the church, the kind of service carried on, and the personal preferences of the responsible authorities. In the interior of the Church of the Sacred Heart, Donnybrook (illustrated), the British Thomson-Houston Co., which was responsible for the manufacture of the appliances used and for the general scheme of the installation, has very successfully aimed at the daylight effect. The main illumination proceeds from units fixed 26 ft. from

Concealed Lighting in a Church.

the ground on the east side of the wooden bracket posts supporting the timbered ceiling. Each unit consists of a three-section battery of Mirolux trough reflectors, containing three 100-watt Mazdalite tubular lamps. In the north and south aisles similar units are fixed on the north and south sides respectively of the spandrels of the main arches. All units point towards the east end of the church, so that the lamps are normally invisible to the congregation. As may be seen from the photograph, which was taken at night by the light of the Mazdalite lamps installed, the illumination is brilliant, and, owing to reflection from the light coloured stone work, is very well distributed.

Sydney Engineer on Electrical Manufacturing in Australia.—The Sydney City Electrical Engineer, reporting to the Electric Lighting Committee on a letter received from Standard Waygood Hercules, Ltd., offering to manufacture electrical plant for the Council on similar lines to those under which G. Weymouth Pty., Ltd., manufacture generating plant and transformers for the Navy Department, based on shop cost, plus 15 per cent. profit, stated that he saw no reason why the Council should not order from this firm in the manner suggested, save in the case of larger or different machinery than anything the company had previously built, or if the Council was dependent on getting apparatus into use on a particular date. In short, he would be strongly in favour of encouraging the making of electrical plant of all kinds in Australia, but would not be prepared to go to the length of risking the Council's ability to meet its obligations to the public by putting plant on order from an Australian company, which in the making of the plant would be experimenting.—*Tenders.*

INSTITUTION NOTES.

Institution of Civil Engineers of Ireland.—At a meeting of the Institution held in Dublin on February 2nd, a paper on "Irish Water Powers and their Places in an Industrial Scheme" was read by Mr. G. Marshall Harriss, M.Inst.C.E.(I.). Mr. Harriss said that Ireland's water power was only limited by the amount of capital they could afford to spend on it. There were throughout the country numerous small water powers that some 80 years ago were in full operation, but to-day for every plant in operation, they would find 50 in ruins. The varying flow of the rivers was a serious drawback, but its significance tended to decrease if they considered a number of powers electrically joined up. The board of the Dublin and Lucan Electric Railway had been considering the possibilities of water power to supplement its steam station, and it had been suggested that the power of the Liffey at the Salmon Leap should be utilised. The total cost of the necessary works was estimated in February, 1919, to be £38,500, or £26 per KW. installed. If the net power proposed was used, the annual output of the station would be 8,385,000 units. The operation costs and capital charges might be taken at £4,600, a total works cost of '138d. per unit generated. The coal required for generating 8 million units at 3 lb. coal per unit came to 10,700 tons. The Dublin and Lucan Electric Railway required about '25 million units; its coal consumption for 1917 was 1,650 tons, and the cost of production was 3'941d. per unit.

Institution of Electrical Engineers.—Mr. Percy Good has been appointed by the Council to be one of the representatives of the Institution on the British National Committee of the International Illumination Commission.

The annual dinner of the North-Western Centre took place at the Grand Hotel, Manchester, on February 6th, Mr. C. J. A. Robertson, chairman of the Centre, presiding. Among the guests were the President, Mr. Roger T. Smith; the Lord Mayor of Manchester (Alderman Fox); the chairman of the Salford Electricity Committee (Councillor Billington); Sir T. Robinson, M.P.; Mr. E. F. Stockton, President of the Manchester Chamber of Commerce; and Mr. C. H. Wordingham.

After the toasts of the King, the Imperial Forces, and the Corporations of Manchester and Salford had been duly honoured, the Chairman presented to Mr. Julius Frith a 4-in. Drummond lathe, and a silver tray (intended for Mrs. Frith), in recognition of his services as hon. secretary during the seven years preceding the present session.

In acknowledging the gift, Mr. Frith said those seven years had been marked by many stirring events, and he hoped to see further developments of the scientific side of Manchester's life and industry. He advocated the establishment of a library which would enable busy men to read the technical Press throughout the world, and keep in touch with all that happened in connection with the subjects they were particularly interested in. Much time would be saved by the employment of a staff of readers whose task it would be to sift the material.

The toast of "The Institution" was proposed by Mr. J. Phillips Bedson, and replied to by Mr. R. T. Smith, who heartily congratulated the North-Western Centre upon the self-sacrifice shown in the establishment of the Sub-Centres at Liverpool and Preston. Decentralisation had been going on for many years, and no one had done more than Mr. Wordingham to bring home the importance of it, and to make the Institution feel that it had got a new life and a new interest. At the same time, the traditions of the Institution were, and must always be, centred in London as the capital of the Empire, of which they were all citizens. Those traditions were an inheritance which should not be lightly parted with. What was obsolete and bad could be discarded, but no change should be made simply for the sake of change.

Mr. C. H. Wordingham, in proposing the toast of "The North-Western Centre," said he did not think it would suffer in any way from the formation of the Sub-Centre. The Institution would certainly benefit. He suggested that the chairman and vice-chairman of the Sub-Centre should be upon the Committee of the Centre, thus linking up in the same way as the Centre was linked up with London by the presence of the chairman and vice-chairman on the Council.

The Chairman, in replying, said the Centres were absolutely loyal to headquarters, but they did not always see eye to eye with it, and there was a feeling that they had not always been dealt with as considerately as they ought to have been. In Manchester there was a very strong Students' Section, which should receive greater recognition; many of the papers submitted by the Students were so meritorious that they ought not to be allowed to fall into oblivion. He suggested the publication of a Students' *Journal*. He further appealed for those men whose training had been interrupted by the war. He agreed that the doors of the Institution should be closed against unqualified men, but in these cases the door might be opened a little wider. He also thought the Membership Committee should take the Local Centres more into its confidence with regard to applications for membership.

The toast of "The Guests" was proposed by Alderman W. Walker, and responded to by Sir T. Robinson, M.P.

An excellent musical and humorous entertainment was provided, and the proceedings were thoroughly enjoyable.

I.E.E. Welsh Conference.—The engineer reported at the Swansea Electricity Committee last week that the Institution of Electrical Engineers would come to Wales in July. It was proposed to make Cardiff a centre, with visits to Bristol, Hereford and Swansea. The other towns were giving civic receptions. Mr. Colwill hoped the Committee would support such a reception. There would be some of the most eminent engineers visiting the town, and if anything would give an impetus to the electrical undertaking and foster industry, this would. It was decided to give a hearty welcome to the visitors, and ask the Mayor to entertain them. The Mayor (who has been a member for 37 years) said the visit would be a red-letter day for Swansea.

A.O.E.C.—The annual meeting of the Association of Officers and Staff Members of Electricity (Power and Supply) Companies of Great Britain will take place at Caxton Hall, Westminster (Room No. 1), at 8 p.m., February 17th. The report of the executive committee states that Sir Alex. B. W. Kennedy, F.R.S., has consented to act as President.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

From 79 original applications for the position of shift engineer at the Swansea Corporation power station, Mr. J. SMITH, a former charge engineer in the Swansea Tramways power station, and senior assistant of the tramways, and now holding a commission in the R.E., was appointed shift engineer, at a salary of £305.

Torquay T.C. has promoted Mr. DENT to the position of station superintendent, at £250 a year; and appointed Mr. MEDWAY as a charge engineer.

The salary of Mr. B. HARTLEY, clerk at the Batley electricity works, has been increased to £175 per annum.

Mr. A. LEWIS, of Preston, has been appointed superintendent at the Doncaster Corporation electricity works, at a salary of £250 per annum.

As we recently announced, the chair of electrical engineering at the University of Birmingham, vacant by the resignation of Prof. Kapp, has been filled by the appointment of Dr. WILLIAM CRAMP, of Manchester. In his report to the Council of the University, the Principal, Sir Oliver Lodge, who has just retired, refers to Prof. Kapp's connection with the University, remarking that he brought a European reputation, as the first professor of engineering. Sir Oliver proceeds: "Electrical engineering, as a university subject, has of late years not been so much in demand as it was in the infancy of the dynamo—in the design and evolution of which Gisbert Kapp took so active a part; but there are signs that in the near future electrical engineering will become of first-rate importance again, not only in connection with large works like the electrical operation of railways, but in the direction of new devices and the utilisation, for practical ends, of many of the discoveries which are being made in pure physics. Some of these have already been of emphatic use during the war."

The *Sheffield Independent* states that Mr. S. S. PARKER has accepted a position on the board of Messrs. John Nicholson and Sons (Sheffield), Ltd., Mowbray Steel Works, and in consequence has resigned his position with Messrs. Vickers, Ltd. Mr. Parker has completed 15 years' service with Messrs. Vickers, Ltd., and for 12 years has had charge of the tool-steel department, together with the crucible and electric furnaces. It is added that Mr. Parker superintended the first commercially-worked electric furnace in this country.

Mr. R. N. TWEEDY having been demobilised, is practising as a consulting engineer at 16, Ely Place, Dublin. He desires to receive catalogues, &c., from firms making electrical machinery, accessories, and fittings; also from firms specialising in fuel economising apparatus, as he will be advising particularly on works economy.

Maidenhead T.C. has appointed Mr. J. DOWSETT, works foreman, as assistant electrical engineer, and Mr. W. STERVELL, mains superintendent, as station superintendent, at £5 per week each.

Mr. J. H. BOWDEN presided at a recent gathering of the Poplar borough electricity department to do honour to ex-Coun. Barge (who was formerly chairman of the Electricity Committee) and Mrs. Barge. Mrs. Bowden, Mrs. Tait, and Coun. Sumner (the present chairman of the Electricity Committee) were among those present. Mr. Bowden said that the suggestion for the gathering came from the men. Mr. Barge had been a good friend to the staff and other employés. The chairman presented Mr. Barge with a set of silver-mounted brushes and mirror, and Mrs. Barge with a gold brooch set with sapphire and pearls. Mr. Barge, in responding, spoke in very high terms of Mr. Bowden as chief of the department. Mr. Fisher having spoken on behalf of the workmen, Councillor Sumner proposed "Success to the Undertaking." The health of the chairman was drunk, and Mr. Bowden, in responding, referred to the honours won by men of the department who joined the Forces.

Mr. C. G. ABBEY, who joined Messrs. Fraser & Borthwick last year, has returned to his former employers, Messrs. Kelsall & Parsons, Glasgow, representives for Scotland of the Lancashire Dynamo & Motor Co., Ltd., and other well-known companies.

Mr. W. BELLAD-ELLIS, the town electrical engineer at Queenstown, Cape Province, has resigned his position. He has had considerable experience in electrical installations with Diesel engines, and will devote his attention to the promotion and development of various similar schemes which he has in hand.

The Middlesbrough Committee has recommended that the salary of the electrical engineer, Mr. R. H. SCOTSON, be increased from £550 to £700 per annum.

The Cape Town Electricity Committee recommended the appointment of Mr. ERNEST STUBBS to the position of temporary assistant engineer at the power station at £720 per annum, with £50 towards passage money. The committee also recommended the appointment of Mr. ARTHUR EDGE as station engineer at £600 per annum and £25 towards passage money.

Mr. E. T. GOSLIN, who has been chief electrical engineer of the Glasgow Corporation Tramways for nearly 20 years, has been appointed general manager of the Clyde Valley Electric Power Co., in succession to Mr. Page, who has been appointed one of the Electricity Commissioners in London.

Mr. J. H. COLLIE has resigned his position of chief electrical engineer with Messrs. Cammell, Laird & Co., Birkenhead, and has started business with Mr. F. B. Cox under the name of Messrs. Collie & Cox, consulting and electrical engineers, at 65, Fleet Street, Liverpool, where they will act as sole district representatives for four well-known electrical firms.

NEW COMPANIES REGISTERED.

Taxi-Calls, Ltd. (163,558).—Private company. Registered January 31st. Capital, £1,000 in £1 shares. To carry on the business of electrical and mechanical engineers, manufacturers of and dealers in electrical and mechanical devices, &c. The subscribers (each with one share) are: C. H. Moore, 5, Craven Mansions, Lancaster Gate, W.2, retired solicitor; N. C. Dibben, B.A., Cantab., Temple Grafton, near Alcester, Warwick. The subscribers are to appoint the first directors. Solicitor: G. A. Herbert, 10, Old Square, Lincoln's Inn, W.C. Registered office: 123, Pall Mall, S.W.1.

John Ogilvy & Co., Ltd. (10,921).—Private company. Registered in Edinburgh January 26th. Capital, £20,000 in £1 shares (10,000 preferred and 10,000 deferred). To acquire and take over the business of an electrical contractor lately carried on by J. D. B. Ogilvy at Inshiwan, Forfarshire, and to carry on the business of electrical engineers and contractors, consulting engineers, &c. The subscribers (each with one share) are: J. D. B. Ogilvy, Inshiwan, Forfar, engineer; B. C. Clayton, Wylands, Ross, Herefordshire, engineer. The first directors are: W. Anderson and J. D. B. Ogilvy. Registered office: 48, Queen Street, Edinburgh.

Hodgson & Partners, Ltd. (163,670).—Private company. Registered February 4th. Capital, £5,000 in £1 shares. To carry on the business of founders, electricians, builders, decorators, and any business in which electricity may be used, and to acquire the business carried on by F. Hodgson at 12, Heath Street, Hampstead. The first directors are: F. Hodgson, 26, Kemplay Road, Hampstead; A. E. Wellman, 77, Devonshire Road, Aldermans Hill, Palmers Green, N.W.13; H. J. Kirby, 51, Larkhill Rise, Clapham, S.W.; H. T. Smith, 78, Thorold Road, Ilford. Solicitor: H. Harrowell, 89, Chancery Lane, W.C. Registered office: 12, Heath Street, Hampstead, N.W.

Keltie's Garage, Ltd. (163,673).—Private company. Registered February 4th. Capital, £10,000 in £1 shares (2,000 preference). To carry on the business of electrical engineers and contractors, garage proprietors, &c., and to enter into an agreement with Capt. H. R. V. Haggett and P. S. Clifton. The subscribers are: Capt. H. E. V. Haggett, 74a, Warwick Road, Earl's Court, S.W. (500 preference and 500 ordinary shares); Capt. A. Y. R. Napier, 19, Piccadilly, W. (1,000 preference). The first directors are: Capt. H. E. V. Haggett, Capt. A. J. T. Haggett and R. S. Clifton. Solicitor: P. B. Shepheard, 28, Young Street, Kennington.

Chase Electrical Manufacturing Co., Ltd. (163,778).—Private company. Registered February 6th. Capital, £6,000 in £1 shares. To carry on the business of manufacturers of and dealers in electrical appliances, apparatus and fittings, &c. The subscribers (each with one share) are: F. Chase, 195, Archway Road, Highgate, N., engineer; G. H. Freeman, 23, Bedford Row, W.C., solicitor. F. Chase is the first director. Registered office: 195, Archway Road, Highgate, N.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Nairobi Electric Power & Lighting Co., Ltd.—Satisfaction to the extent of £1,000, registered January 16th, 1920, of charges registered September, 1913, and July, 1915.

New Shipston Lighting Co., Ltd.—Debenture for £1,150, registered January 8th, 1920, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: J. R. King, J.P., Honnington Hall, Shipston-on-Stour.

Kidderminster & District Electric Lighting & Traction Co., Ltd.—Satisfaction registered December 31st, 1919, of £42,500, being total issue under charge registered April 10th, 1905.

Oriental Telephone and Electric Co., Ltd.—Satisfaction registered December 16th, 1919, to the extent of £4,100 of charges registered July, 1905, and June, 1907.

Rhondda Tramways Co., Ltd.—Satisfaction registered December 24th, 1919, to the extent of £4,900, of charges registered April 3rd, 1911, November 19th, 1912, and March 19th, 1915.

City of Oxford Electric Tramways, Ltd.—Satisfaction registered December 24th, 1919, to the extent of £1,400, of charge for £40,000 registered February 25th, 1914.

Ingleton Electric Lighting & Power Co., Ltd.—Particulars filed January 1st, 1920, of £1,750 debentures, charged on the company's undertaking and property, present and future, including uncalled capital, amount of present issue being £1,250.

W. A. & R. J. Jacobs, Ltd.—Debenture to secure £3,000, registered December 24th, 1919, charged on land and building, at Edgware Road and Hendon, and the company's undertaking and property, present and future, including uncalled capital, except leases of 94 and 96, Leonard Street, and 53 and 55, Great Eastern Street, London. Holders: L.C.W. & Parr's Bank.

Lancashire Electrical Engineering Co., Ltd.—Mortgage on land and shop, 213, Old Street, Ashton-under-Lyne, Volt Works, &c., registered December 24th, 1919, to secure £600. Holder: W. Bardsley, 13, Canal Street, Hyde.

Lithanode, Ltd. (formerly Longstreths, Ltd.).—Debentures for £3,000, registered January 2nd, 1920, charged on the company's undertaking and property, present and future, including uncalled capital.

CITY NOTES.

British Columbia Electric Railway Co. Ltd.

Mr. G. P. Norton presided at the annual meeting on February 3rd. He read a statement prepared by the chairman, Mr. R. M. Horne Payne, in which the latter referred to the fact that they met under much more pleasant circumstances than at any meeting since 1913. Not only were they able to recommend modest dividends, but the outlook for the future was encouraging. Trade and industry in British Columbia had prospered satisfactorily since the end of the war, and were now based on stable and permanent conditions. So long as the company received fair treatment they had nothing to fear for the future. The ordinary net revenue was better than in the previous year by £20,993, and there was also an additional £138,419 arising from causes mentioned in the report. It was impossible to say for how long the revenue might be augmented as the result of the rate of exchange for remitting money from Vancouver to London. The bonus of 3 per cent. on the deferred ordinary stock must be looked upon as an entirely exceptional distribution, and not regarded as likely to recur in future years. On the other hand, the improvement in local conditions was such as to justify the belief that the time had returned when they might hope to be able to make an annual distribution of dividend on the deferred ordinary stock. Their hopes in this respect were encouraged by the increase in earnings during the first six months of the current year, which, as compared with the previous year, showed an increase of $382,590. Although increases at this rate might not, and probably would not, be maintained, and a large increase in the wages bill had to be faced, the improvement was encouraging, and they relied on the fact that the Public Utilities Commission was directed by the Act, in fixing any rates, to have regard to providing a fair and reasonable return upon the appraised value of the company's property. The chairman proceeded to refer to the developments that had taken place in connection with fares in Vancouver City. It was expected that there would be some amending legislation passed early next year when the adjourned inquiry and appraisal would no doubt be resumed. Mr. John Davidson, one of the directors, who recently returned from a visit to British Columbia, addressed the meeting at length, and spoke with confidence regarding the state of the undertaking, and regarding the future. The chairman said that if they looked forward 30 years they would probably see Vancouver a great city like Liverpool; their enterprise had great possibilities.

Yorkshire Electric Power Co.

The net profit for the year ended December, 1919, after payment of mortgage and other interest was £54,133 (against £46,536 for 1918 and £33,258 for 1917), plus £10,225 brought forward. The dividend of 6 per cent. per annum on the cumulative preference shares requires £11,403; a dividend of 8 per cent. on the ordinary shares absorbs £20,358; there is put to general reserve (increasing it to £74,000) £15,000, and £17,596 is to be carried forward. Notwithstanding the change from war to peace conditions, the substantial progress made during past years has been maintained. The dividend compares with 7 per cent. for 1918, and 5 per cent. for 1917. In future dividends on the ordinary shares will be paid half-yearly. £96,460 ordinary capital has been subscribed during the year. The directors note with satisfaction the growing practice of power users to invest capital in the company in place of installing small units of power plant in their works for their sole needs. The company's consumers and directors of companies taking supply now hold more than one-fifth of the issued capital. During the year there was a large growth in the revenue on account of energy supplied both to individual power users and to authorised distributors. The continued increase in the cost of coal has emphasised the advantages of the company's supply to power users, and additional generating plant is required to meet the large and increasing demands for current, and the board will shortly bring forward proposals for raising the necessary capital. A commencement of bulk supply has been made to the Spenborough and Elland Urban District Councils, and terms have been agreed with the Corporations of Batley, Dewsbury, Todmorden, and Wakefield, from which a considerable demand will arise. "The company was formed in 1901 for the purpose of producing electricity on a large scale, and unifying supply over a wide area. The Government Electricity (Supply) Act . . . confirms the soundness of this policy. The Act further introduces certain legislative amendments which should facilitate future developments." Annual meeting, February 17th, at Leeds.

Melbourne Electric Supply Co. Ltd.

The report for the year ended August, 1919, now issued, refers to the effect of the strike of seamen in Australia and the shortage of fuel, leading to restrictions in the use of electricity (especially of power) which caused serious reduction in revenue. Gross profit on the Melbourne and Geelong undertakings £180,161, against £161,887 for the previous year, an increase of 11 per cent. After meeting London office expenses and debenture, &c., interest, and sinking funds, &c., £1,134 is written off capital expenditure, £10,000 is put to reserve for income tax and excess profits duty, £20,000 to gold bonds redemption account, and £20,501 to reserve. Dividends of 7 per cent. on the first cumulative preference shares and 10 per cent., free of British income tax, for the year on the ordinary, £50,051 is carried forward. Since the close of the year the directors have issued 20,000 preference shares at par, and are now offering 100,000 ordinary shares of £1 each at 5s. premium to the existing holders of consolidated ordinary stock (one new share for each £5 held). We extract the following figures:—

	Melbourne.		Geelong, inc. trams.	
	Aug., 1918.	Aug., 1919.	Aug. 1918.	Aug. 1919.
Consumers	36,870	42,430	3,148	3,374
Lighting, &c., in KW...	31,740	36,189	2,843	3,082
Motors (rated H.P.) ...	27,640	30,318	2,392	2,415
Total connections, KW.	59,380	66,507	5,235	5,497
Total units sold ...	32,839,227	35,069,000	1,677,700	1,551,042

Increase in consumers, 5,560 (15 per cent.); power supply 30,318 H.P. (increase 10 per cent.); total connections increase, 12 per cent.; total units sold, increase 7 per cent.; gross revenue, increase 6 per cent. Notwithstanding the heavy increase in the cost of labour, fuel, and materials generally, the company was able to avoid making any increase in its charges to consumers during the year.

London Underground Electric Railways.

Underground Electric Railways Co. of London, Ltd.—Interest at 1 per cent., free of tax, on the 6 per cent. income bonds of 1948 for the half-year. £34,000 carried forward. (Last year, 3 per cent.)

London Electric Railway Co.—Final dividend of ¼ per cent. on the ordinary shares, making 1¼ per cent. for the year; £20,942 carried forward. (Last year 1¼ per cent., making 2 per cent. for the year.)

City & South London Railway Co.—Final dividend of 1 per cent. on the consolidated ordinary stock, making 2 per cent. for the year, the same as last year; £24,367 carried forward.

Central London Railway Co.—Final dividend of 1¼ per cent. on the undivided ordinary stock, making 3¼ per cent. for the year; final dividend of 2 per cent. on the preferred ordinary stock, making 4 per cent. for the year; dividend of 3 per cent. on the deferred ordinary. Carried forward £11,762. (Last year 4 per cent. on the undivided and 4 per cent. on the deferred.)

Metropolitan District Railway Co.—Final dividend of 1¼ per cent. on the 5 per cent. second preference, making 4 per cent. for the year. Carried forward £22,098.

Yorkshire (West Riding) Electric Tramways Co., Ltd.

Presiding at the annual meeting on Friday last, Sir H. S. Leon referred to the demands of labour and the question of fares. They fully recognised the right of all to demand higher wages in proportion to the rise in prices of articles of necessity, but they had also to recognise the rightfulness of the demand of investors for a fair return on their money. The board claimed that if a statutory wage was to be given there should be an alteration in the statute which fixed fares. It was impossible for such transport systems to work satisfactorily under existing conditions, tied on the one hand by the obsolete and inadequate statutory fare of one penny per mile, and on the other hand being compelled to grant the demands of labour to pay the extortionate prices demanded for the materials which they must have. The Government, regardless of any principle of justice, had until now turned a deaf ear to the owners of transport systems. For nine years no return upon their capital had been received. They were quite justified in demanding that as the cost of providing transport had so enormously increased, they should be given permission for a reasonable increase in the fares. The fare privileges given to the class called "working" should be revised, they were in a great many instances receiving considerably higher wages than many others in trade and business, and a halfpenny per mile was most unfair. The company's only hope was that the Government would in the immediate future deal fairly with the transport industry and permit them to raise their fares reasonably. The company's total revenue for the year increased by £16,518 (11.9 per cent.) to £157,086, but the operating expenses increased by £17,488 (23 per cent.) to £92,172. The wages bill for 1919 was 40 per cent. higher than for 1918, and 188 per cent. higher than for 1914. They would see the effect of a full year's operation of the wages awards of last year during 1920. They had paid the 6 per cent. dividend on the preference shares and purchased funded dividend certificates of £21,047 for £12,837. They had put £14,259 to renewals and depreciation. When the time came for large renewals to be undertaken they would cost more than they had contemplated in the old days, and they must make ample provision for these increased prices. The chairman later said that the manager, Mr. H. England, had had an anxious year, and he was going to have an equally anxious one in 1920. He wished publicly to acknowledge his services.

Costa Rica Electric Light & Traction Co., Ltd.—Year ended June 30th, 1919, net earnings in Costa Rica, after charging all expenses, £14,928, an increase of £3,824. Net deficit for the year £2,549, against £6,646 in the previous year. The gold premium has averaged 315 per cent. during the year, as against 345 per cent. in the previous year, and

112 per cent. (the normal equivalent of the gold "Colon") in the year (1913-14) before the war. The depreciation of the company's profits caused by the fall in the value of the national currency is shown by the following figures: The net earnings in Colones for the year under review amounted to C.297,305—a record in the operations of the enterprise. At the normal exchange of 112 per cent. premium, or 10.60 to the £ sterling, these colones would have realised £28,047—so that the loss on exchange for the year was no less than £13,719. The interest on the 6 per cent. prior lien bonds has been paid in cash, but the holders of the 5 per cent. debentures received their interest in deferred warrants. Since the end of the financial year there has been a substantial rise in the sterling value of the colon, and should this continue they have every hope of being able to resume payment in cash of the interest on the 5 per cent. debentures on June 30th next.

Metropolitan Railway Co.—Report for the year ended December, 1919. Receipts, £1,712,952; expenditure, £1,279,074. Other receipts, £203,450. Total net income, £637,328, plus £19,211 brought forward. After deducting interest, renewals, appropriation, &c., £316,752; preference dividend, £239,107; and ordinary dividend, 25s. per cent. per annum; £19,864 is to be carried forward; £40,000 is put to general renewals, as against £20,000 in 1918. Though there has been a large increase in traffic, expenses have grown in a much greater ratio by reason of Government concessions to the staff and the higher cost of coal and other commodities. Consequently the amount received from the Government under their guarantee is considerably larger than in 1918. The passenger fares must be raised, and steps are being taken to this end in conjunction with the other London transport companies. Additions to rolling stock and electrical plant have become imperatively necessary, and orders have been placed for new trains and locomotives; negotiations are proceeding for the erection of additional generating plant at the Neasden power house.

Automatic Telephone Manufacturing Co., Ltd.—An explanation of the dividend disappointment in regard to this company has been issued, from which it appears that many of the patents have expired and others have but a comparatively short life, these patents representing £240,000, or 40 per cent. of the capital. Negotiations with an international syndicate have been entered into for the formation of a new concern under the title of International Automatic Electric Co., to acquire the right to carry on business in eleven European countries where the present company has no such right. The new company, it is proposed, shall have a capital of £920,000 in 200,000 7 per cent. cumulative preference, 360,000 ordinary, and 360,000 deferred, all of £1 each. The new preference will be exchangeable for those now in existence, while the whole of the new deferred will go to the syndicate as consideration for provision by the syndicate of additional capital for extensions up to £100,000, and manufacturing orders carrying a fixed percentage of profit from countries outside of United Kingdom to the following minimum amounts: £100,000 in 1920, £150,000 in 1921, and of £200,000 per annum in 1922 to 1927 inclusive. The ordinary and deferred shares will rank equally for further participation in the profits after each class has received 6 per cent.—*Financial Times.*

Tyneside Tramways & Tramroads Co.—The report shows that the surplus of receipts over expenses for 1919 was £7,177, plus £1,758 brought forward. Interest on mortgages, loans, &c., £1,349; 5 per cent. preference dividend, less tax; 5 per cent., less tax, on the ordinary; to reserve for renewals, depreciation, &c., £1,400; carried forward £2,237. For the year the traffic receipts showed an increase of £7,239. Car miles, 650,745 in 1919, against 647,980 in 1918; passengers carried, 11,637,053 in 1919, against 11,778,103 in 1918; total traffic receipts, £59,820 in 1919, against £52,581; gross profit, £14,120 in 1919, against £18,243.

General Electric Co., Ltd.—An extraordinary meeting will be held on February 14th for the purpose of passing resolutions making the 1,655,790 issued preference shares and 144,210 of the unissued preference shares "A" preference shares, and the 1,800,000 preference shares at present unissued 7½ per cent. "B" cumulative preference shares. The capital will then be £6,000,000, divided into 1,800,000 6½ per cent. "A" cumulative preference shares of £1 each, 1,800,000 7½ per cent. "B" cumulative preference shares of £1 each, and 2,400,000 ordinary shares of £1 each.—*Financial Times.*

National Gas Engine Co., Ltd.—Net profit for the year ended December, 1919, after providing for depreciation and allowing for management salaries, excess profits duty, and income tax, £106,387. Interim dividends of 5 per cent. per annum on the preference and 7½ per cent. per annum on the ordinary have been paid, and final dividends at the same rates are now to be paid, both less income tax, together with a bonus of 1s. per share (free of tax) on the ordinary shares. £50,000 is put to reserve fund and £46,174 is to be carried forward.

Globe Telegraph & Trust Co., Ltd.—Final dividend 14s. per share, making 10 per cent. net on the ordinary shares. Existing holders are being offered 60,376 ordinary shares at par in the proportion of one new share for every three now held. The *Financier* states that this issue is to enable the company to take up its proportion of the new issues of the Eastern and Eastern Extension Companies.

Spanish & General Wireless Trust, Ltd.—The "Financial Times" states that for the year ended June, 1919, the profit was £5,500, plus £483 brought forward, making £5,983 to be carried forward. The company will go into voluntary liquidation for selling the whole of the assets for fully-paid shares in a new company with wider powers.

St. James' & Pall Mall Electric Light Co., Ltd.—Balance dividend on the 7 per cent. preference shares for the half-year ending December 31st, 1919, of 3s. 6d. per share, and 8s. 6d. per share on the ordinary shares, making with the interim dividend a total of 12 per cent. for the year.

Vulcanite, Ltd.—Dividend at the rate of 10 per cent. per annum, less tax, and a bonus of 6d. per share, free of tax; bonus of 6d. per share on preference shares, free of tax. The capital is to be increased to £150,000 by the creation of 50,000 new ordinary shares of £1 each.

Stock Exchange Notice.—The Committee has ordered the undermentioned to be officially quoted:—

Vera Cruz Electric Light, Power & Traction, Ltd.—350,000 shares of £1 each, fully paid (Nos. 1 to 350,000).

Central Electric Supply Co.—£22,766 has been transferred to depreciation fund, £400 written off for discount on issue of debenture stock, and £6 is to be carried forward.

Hong-Kong Tramway Co., Ltd.—Final dividend of 1s. 3d. per share, making 2s. for the year 1919. Carried forward, £7,116.

Crossley Bros., Ltd.—Dividend at the rate of 10 per cent. per annum on the ordinary shares for the half-year, making 8 per cent. for the year.

Frederick Braby & Co., Ltd.—Interim dividend of 5 per cent. on the ordinary shares, less tax.

Fellows Magneto Co., Ltd.—This company is offering for sale 250,000 ordinary shares of 10s. each at 18s. 6d. each.

Underfeed Stoker Co., Ltd.—Interim dividend at the rate of 5 per cent., less tax.

Smithfield Markets Electric Supply Co., Ltd.—Dividend of 2 per cent. on the ordinary shares for 1919. £1,300 carried forward.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange markets are in a rather hesitant mood. The King's speech on Tuesday was read favourably, but it is felt that the general position both at home and abroad contains so many elements making for doubt and uncertainty as to cause investors to wait before venturing far into new commitments. The shadow of the Budget is at hand, and is bound to exercise a depressing influence for the next few weeks. This is felt, of course, mainly in the markets concerned with gilt-edged issues. Although it is frequently argued that whatever is bad for fixed-interest stocks must of necessity operate in the opposite direction where more speculative descriptions are concerned, the tide of enterprise in Stock Exchange markets is distinctly checked.

There was sharp disappointment at the dividend declaration of the Underground Electric Railways of London. That the income bonds would get their full 3 per cent. many men did regard as doubtful, but it was not expected that the rate would be dropped to 1 per cent., and, on this being announced, the price of the shares fell 8 points to 76, from which there was a trifling recovery as bolder buyers came in. Jobbing backwards, it is hardly surprising that the company should not have made the best of things, seeing how matters now stand between it and the Government, and some seem to think that in normal circumstances the board might have managed to squeeze out 2 per cent. However that may be, the market for the ordinary and the shilling shares, after being flat, rallied to some extent, and both issues show improvements. London and Suburban and similar shares keep on the dull side. Districts have fallen back to 20.

Business is less active amongst the shares of the home electricity companies, but further rises have occurred in Bromptons, Charing Cross, Kensington and St. James, though City ordinary at 13¾ are 5s. down after their rapid and continuous rise. The dividend declarations are being awaited with unusual interest, though the optimists are fortifying themselves against possible disappointment by saying that the industry as a whole cannot be expected to recover to any noticeable extent until the current twelvemonth.

In the manufacturing group, Edisons have gone back to 25s., and British Aluminiums are a few pence lower. Of the telegraph shares, Callender's at 9¾ shed their gain of last week, but Telegraph Constructions continue on the upward grade, and at 28¾ are another £1 to the good. Various preference shares are dull, as the holders sell them in order to exchange into ordinary with greater prospects of advance in capital value. The new issue of the General Electric Company, referred to last week in this column, seems to be generally expected.

One very unpleasant feature of the week is a sharp fall in the price of Automatic Telephones, which slumped from 35s. to 22s. on the directors' decision not to pay any dividend in respect of 1919. The announcement was followed by a long

circular setting forth that the company has been doing badly since the armistice, and that in its present condition there is little hope of improvement. It is proposed to form a new concern, with power to operate in various foreign countries and to transfer the interests of the Automatic Telephone to the newcomer. The scheme is certainly not conducive to immediate hopefulness for holders who paid higher prices for their shares, and the whole thing has come as a bombshell to those who were looking for improvement in the price, on the idea that the British Government would probably take over the company as a nucleus of a new automatic system for general use.

The cable market is not quite so good, Eastern ordinary at 195 being 5 points and China shares 10s. lower, though the remaining members of this group hold their substantial rises which occurred on the increased dividend announcements. The Globe Telegraph has come into line with a 10 per cent. dividend and new capital proposals. Strength stands out in Marconis, which have risen to 4 3-16 on a return to favour of the Marconi group as a whole. Marines stiffened to 2 13-16 and Americans rose to 30s. 6d., with a fair amount of business doing in all the shares. Another dramatic jump occurred in Bombay Tramways, the price soaring to 128. To the inquisitive, the extraordinary price is almost exasperating. The preference are harder at 15½. Brazilian Tractions shed a couple of points. An odd anomaly is shown by Anglo-Argentine first preference being lower than the second preference. This may be partly explained by the fact that the seconds carry more arrears of dividend than their seniors.

Cromptons are a good market at 22s. 6d., and Babcocks rose to 3⅞. The armament and kindred groups remain somewhat undecided. Rubber shares are quiet and out of fashion. Revival in South Africans has diverted interest from base metal mining shares.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1917.	Dividend 1918.	Price Feb. 10, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	8	6½	+ ¼	£6 7 0
Charing Cross Ordinary	4	4	5⅞	+ ⅛	5 6 8
do. do. do 4½ Pref.	4½	4½	2⅞	—	8 8 8
Chelsea	5	5	3⅛	—	4 12 4
City of London	8	8	13½	— ½	5 16 4
do. do. 6 per cent. Pref.	6	6	9⅛	—	6 4 8
County of London	7	7	9⅞	+ ⅛	7 3 7
do do 6 per cent. Pref.	6	6	9	—	6 13 4
Kensington Ordinary	7	6	5½	+ ½	5 14 3
London Electric	Nil	Nil	1⅛		
do. do. 6 per cent. Pref.	5	6	9½	—	8 11 6
Metropolitan	4	5	9⅞	—	6 13 4
do. 4½ per cent. Pref.	4½	4½	2⅝	—	7 16 6
St. James' and Pall Mall	9	10	6⅛	+ ⅛	7 13 10
South London	5	5	2⅜	—	7 12 8
South Metropolitan Pref.	7	7	1	—	7 0 0
Westminster Ordinary	9	8	6	—	7 10 0
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	9½	—	8 11 2
do. Def.	1½	32/6	21•		7 1 2
Chile Telephone	8	8	8⅜	—	6 5 6
Cuba Sub. Ord.	7	7	10⅜	—	•6 14 4
Eastern Extension	8	8	19½	- ½	•5 2 7
Eastern Tel. Ord.	8	8	195	- 5	•4 2 7
Globe Tel. and T. Ord.	7	8	20	—	•4 18 6
do. do. Pref.	6	6	9¼	—	6 6 4
Great Northern Tel.	22	22	26½	—	8 6 0
Indo-European	13	13	19⅝	—	6 13 4
Marconi	20	25	4 3/16	+ ⅛	6 0 0
Oriental Telephone Ord.	15	10	9 7/16	—	4 16 0
United R. Plate Tel.	8	8	8	— ½	•5 0 0
West India and Panama	1/3	1/3	1-7/16	—	5 9 6
Western Telegraph	8	8	20½	—	•4 17 7
Home Rails.					
Central London Ord. Assented	4	4	68½	—	6 16 9
Metropolitan	1	1½	23	—	5 8 8
do. District	Nil	Nil	20	— ¼	Nil
Underground Electric Ordinary	Nil	Nil	2⅞	+ ⅛	Nil
do. do. "A"	Nil	Nil	6/-	+6d.	Nil
do. do. Income	4	5	75	—3	—
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	85	—	7 14 10
Anglo-Arg. Trams, First Pref.	5½	Nil	38	- ½	—
do. do. 2nd Pref.	—	—	8½	—	—
do. do. 5 Deb.	5	5	64½	—1	7 15 0
Brazil Tractions	—	—	55	—2	—
Bombay Electric Pref.	6	6	15½	+½	3 17 8
British Columbia Elec. Ry. Pfcs.	5	5	64	—	7 15 0
do. do. Preferrred	Nil	2½	57½	—	8 13 10
do. do. Deferred	Nil	Nil	52½	—	5 14 3
do. do. Deb.	4½	4½	64	—	6 15
Mexico Trams 5 per cent. Bonds	Nil	Nil	46	—	Nil
do. 6 per cent. Bonds	Nil	Nil	85½	—	Nil
Mexican Light Common	Nil	Nil	22½	—	Nil
do. Pref.	Nil	Nil	35	—	Nil
do. 1st Bonds	Nil	Nil	52½	—	—
Manufacturing Companies.					
Babcock & Wilcox	15	15	3⅞	+ ⅛	•4 2 9
British Aluminium Ord.	10	10	1 15/16	— 1/16	5 16 3
British Insulated Ord.	25	12½	2⅛	—	5 14 2
Callenders	25	25	9⅝	— ¼	6 9 10
,, 6½ Pref.	5	6½	4⅜	— ⅛	7 0 6
Castner Kellner	25	20	4	—	—
Crompton Ord.	7	10	22/6	+1/-	8 17 10
Edison-Swan, "A"	—	10	1½	— 1/16	8 0 0
do. do. 5 per cent. Deb.	4	5	79½	—	6 5 9
Electric Construction	10	10	1½	—	8 0 0
Gen. Elec. Pref.	6	6½	19/6	—	6 13 4
do. Ord.	10	10	41/-	—	•4 15 8
Henley	25	25	2⅛	—	5 14 2
do. 4½ Pref.	4½	4½	3¼	— ⅛	6 4 2
India-Rubber	10	10	15½	— ½	•6 9 0
Met.-Vickers Pref.	—	—	3-1/16	+ ⅛	5 0 4
Siemens Ord.	—	10	28/	—	•7 2 10
Telegraph Con.	20	20	28½	+1	•4 2 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, February 10th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/5	...
a Ammoniac Sal	per ton	£95	...
a Ammonia, Muriate (large crystal)	,,	£75	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£42	...
a Copper Sulphate	,,	£51	£3 inc.
a Potash, Chlorate	per lb.	11d.	...
a ,, Perchlorate	,,	1/-	...
a Shellac	per cwt.	£44	...
a Sulphate of Magnesia	per ton	£15	...
a Sulphur, Sublimed Flowers	,,	£28	...
a ,, Lump	,,	£25	...
a Soda, Chlorate	per lb.	6d.	...
a ,, Crystals	per ton	170/-	...
a Sodium Bichromate, casks	per lb.	...	...
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£118 to £345	...
c Brass (rolled metals 12" to 12" basis)	per lb.	1/4	½d. inc.
c ,, Tubes (solid drawn)	,,	1/1½ to 1/7½	½d. inc.
c ,, Wire, basis	,,	1/4½	½d. inc.
c Copper Tubes (solid drawn)	,,	1/10	½d. inc.
g ,, Bars (best selected)	per ton	£171	£4 inc.
g ,, Sheet	,,	£171	£4 inc.
g ,, Rod	,,	£171	£4 inc.
d ,, (Electrolytic) Bars	,,	£132	£7 inc.
d ,, ,, Sheets	,,	£156	...
d ,, ,, Wire Rods	,,	£147	£7 inc.
d ,, ,, H.C. Wire	per lb.	1/6	½d. inc.
f Ebonite Rod	,,	3/-	...
f ,, Sheet	,,	2/6	...
g German Silver Wire	,,	3/-	3d. inc.
h Gutta-percha, fine	,,	13/-	...
h India-rubber, Para fine	,,	2/7	½d. dec.
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£48 10/-	...
g Lead, English Pig	,,	£50 10/-	55/- inc.
g Mercury	per bot.	£22 10/-	10/- dec.
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
e ,, ,, ,, large	,,	12/6 to 25/- & up	...
g Phosphor Bronze, plain castings	,,	1/8 to 2/-	...
g ,, ,, rolled bars and rods	,,	2/2 to 2/6	...
g ,, ,, rolled strip & sheet	,,	2/3 to 2/9	...
d Silicium Bronze Wire	per lb.	1/11½	½d. inc.
r Steel, Magnet, in bars	,,	1/7	...
g Tin, Block (English)	per ton	£391 to £392	£4 inc.
n ,, Wire, Nos. 1 to 16	per lb.	5/3	3d. inc.
White Anti friction Metals	per ton	£90 to £345	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormston & Sons.
r W. F. Dennis & Co.

Victoria Falls.—The *Financial Times* recently recorded the results of a survey of the Victoria Falls and an investigation into the possibilities of their employment for the production of electrical energy. The velocity of the Zambesi at the lip of the falls was found to be 700 yards per hour, giving an estimated volume of 704,970 cu. ft. per minute. The maximum available head was stated to be 380 ft. to the level of the tail water; about 10 ft. of this would be deducted for the height of the turbines above the surface of the water. To allow for the rise of the water in the canon during the flood period, the turbines would necessarily have to be constructed at a much greater height, probably 65 ft. above the normal level, thus reducing the head to about 315 ft. Mr. C. W. Carter, the author of this report (furnished by the Rhodesian Munitions and Resources Committee), states that unreliable data previously issued estimated the power possibilities of the falls at about one hundred times more than could be arrived at by actual measurements. As far back as November 24th, 1905, however, the ELECTRICAL REVIEW gave a report of the investigations of the African Concession Syndicate, which will be found to agree very closely with the results of this later survey of the position. The syndicate in conjunction with leading Continental and American engineers, computed the available head as being 330 ft., actually less than that now reported. Mr. Carter estimates the electrical equivalent of the power available as 263,000 KW., allowing an efficiency of 85 per cent., and including further losses due to pipe friction, &c. The syndicate stated that a total of 500,000 H.P. could be utilised, which is equivalent to about 300,000 KW.

It will be seen from this that there is not such a great disparity between the present calculations and those of fourteen or fifteen years ago. The falls, however, are still 700 miles from the Rand, and the prospect of spanning that distance with a transmission line seems to be equally remote.

TRANSFORMERS FOR ELECTRIC FURNACES.

At Manchester, on January 27th, Mr. J. L. Thompson's paper, an abstract of which appeared in our issue of January 30th, was read and discussed before the North-Western Centre of the Institution of Electrical Engineers.

Mr. H. G. Furlong agreed generally with the author's opening remarks, but protested against the comparison which he made between the core and the shell type of transformer. Coils wound in a continuous length were suitable either for the core or circular shell-type transformer. The same machine was capable of winding coils for a rectangular shell-type transformer, and circular turns could be wound in one continuous length; so that the difficulty of the joints was entirely overcome. In the rectangular-shell type there was a greater length of core on which the leakage flux would cut the punching in a parallel direction on the core tapping, but at the same time there was a greater amount of iron in the rectangular-shell than in the core type, so that so far as the losses due to leakage flux were concerned, there was no difference between the two types. Surely the author did not design a core-type transformer for furnace work with H.P. tappings unless they were put in the centre of the winding so as not to interfere with the reinforced turns, or materially affect the balance of load in the L.P. parallel coils. The same arrangement could be made on the core type as on the shell type. The author stated in London that twelve times as many breakdowns occurred in the core type as on the shell type transformer, and that it was, therefore, necessary to make the core-type transformers so that they could be repaired on site. That was a mis-statement so far as the manufacture of transformers generally was concerned. With regard to the tappings, he was in entire agreement with the author. If the tappings could be entirely omitted the transformer would be much more reliable. Boosters or induction regulators could be used for regulating the voltage, and if these broke down the main transformer could still be used for working the furnace as the author suggested. His patent for obtaining half turns was very ingenious, but considerable difficulty would probably be experienced due to the extra length of L.P. lead which was necessary to bring the end of the half turn from the bottom of the transformer through the top of the tank. Also a considerable amount of additional reactance would be caused, and additional losses, due to the half turn encircling the bottom cast-iron base and the top casting. Further, the heavy leads would have to be joined at the bottom of the tank where it was almost impossible to inspect. If these objections could be overcome his patent would make it possible to obtain a very much more economical proportion of material on the shell-type transformer. Furnace lay-outs were usually in the hands of the furnace manufacturers, with the result that there were very few lay-outs (if any) in this country that could not be considerably improved.

Dr. Miles Walker explained that a great deal of trouble had arisen through careless original lay-out, and very often it had been difficult to reduce the reactance to the right amount. In this connection, he believed that many engineers who were dealing with the matter did not fully appreciate the fact that one could reduce the reactance just as well by increasing the diameter of the leads. In actual practice most electric furnaces used about ten times more copper than was needed, because nine-tenths of the copper was not carrying any current at all, or it might even be carrying current in the wrong direction. Increasing the voltage in the transformer was not always possible, on account of the internal conditions of the furnace. Another matter was that the low power-factor on the L.T. side of the furnace was not entirely due to the reactance of the leads. He had made some definite calculations, and was quite convinced that a phenomenon, which might be called delayed resistance, existed.

Mr. J. Frith was surprised that a more intimate connection had not been established between switchgear and transformer designers. Large transformers were at the mercy of the switchgear, and usually the failure of a transformer was—at any rate by its designer—put down to failure of the switchgear control; the paper was a little inadequate in that respect. The effect of the arc might introduce a great difficulty in the design of the transformer; there was very often a double swing in change over of current, in a purely arc furnace.

Mr. A. G. Ellis thought it rather a pity that the paper was more or less confined to one class of (steel) furnace, and almost to one type of transformer. The manufacturers of arc resistance furnace apparatus, and of the electrical gear connected therewith, had had rather a rough run for their money; they had to buy experience sometimes under very strange conditions. Now that the war conditions were over, and they had got behind them most of their troubles, there was a lull in the demand for apparatus, and they could not apply to the extent that they desired the experience they had gained. Even now there were certain points in specifying transformers and electrical equipment for electric furnaces which tended to give the customer a worse piece of apparatus than he would really get if he simply said what he wanted, and left it to the manufacturer to make the apparatus. Some engineers thought they would get a better rated piece of apparatus by specifying the actual current. He put in a plea for the British standard rating, especially with this class of apparatus. If they could get down to a standard rating it would be to the general benefit both of the engineers who installed plant and the manufacturers who made it. He was surprised that the question of core *versus* shell type of transformer had been raised. He thought they had settled that last year. There was really nothing in this controversy; it depended on the views formed from experience and what one had been brought up to. Increasing the power of the furnace was a matter which exercised the furnace-makers very much. To increase the number of phases *ad lib.* was rather dangerous, because the more phases there were the more complicated was the switchgear, and consequently greater liability to break down. The difficulties associated with half-turn design were chiefly mechanical ones. Low pressure leads had given rise to more trouble than anything else.

Mr. R. G. Mercer explained that from experience gained when at the Ministry of Munitions, he very quickly found that the transformer maker—no matter who he was—was the last person, generally speaking, to blame for the failure of transformers in electric steel furnaces. In the first place, the furnace maker was partly to blame, because in those days he traded very largely on the transformer manufacturers' guarantee that the transformer would stand up to 20 per cent. overload for a considerable period of time, and the consequence was that he used the full capacity of the transformer without any thought of temperature rise or the overload which the transformer was subjected to, quite apart from all question of surge. As time went on, it began to be appreciated that the transformer was the most important part of an electric furnace, and its breakdown involved in nearly every case very great delay, whereas a breakdown in any of the auxiliary gear was a matter of small moment. Mr. Thompson had not mentioned anything about present methods whereby surges were very largely limited. They had now an automatic voltage-current regulator which took care of the furnace from the initial cold stage, and some of the furnaces in this country were being converted to the new method, and the rest, in a short time, would begin to follow. The proposal to raise the voltage had disadvantages, and the user would obviously suffer unless he had a carbonaceous atmosphere.

Mr. A. Ratcliffe's views, apart from the question of design, were generally in agreement with the opinions expressed in the paper. It was only right that the supply company should have the power of imposing such restrictions as would ensure that the supply to other consumers would not be interfered with by the operation of furnaces. Presumably any authority which undertook to supply a furnace would be able to deal with 1.6 and 2.3 times the normal load, but he did not think they should be expected to deal with the enormous surges and rushes which occurred. Failure of insulation of switchgear and transformer terminals, &c., might have been due to the heavy auto-transformer effect, but he felt that in many cases it had been due to surges arising from furnace conditions, and that they were more likely under the conditions which arose when transformers were switched into circuit. He had seen evidence of sparks having flashed across distances of 4 or 5 in., and, of course, the results were disastrous. It showed that the strain on switchgear, end turns, and transformer windings was a very real one. Fortunately, experience had shown that in many cases the cure for this state of affairs was the insertion of auxiliary contacts in the switches with charging resistances between the main and the auxiliary contacts, to enable the transformer to push up magnetisation, and avoid the rush when the main contacts came in. It was also possible for these surges to take place in switching out a transformer, which fact could only be put down to some effect due to chattering contacts on the switches, such contact being frequently the cause of surges. External reactances should be fixed as near as possible to the cable head, immediately after the isolating links; otherwise one would simply have, as he had seen in the last fortnight, a current transformer acting as a choke coil. The normal pressure between the terminals of the transformer and earth would be about 3,800 volts. Actually the arc flashed over through a ¼ in. thickness of Empire cloth giving a spark voltage, by estimate, of not less than 100,000 volts, which was conclusive proof that the trouble was not imaginary. It would be minimised to some extent by an increase of the supply pressure. The H.P. cables would, he thought, be capable of absorbing the shocks to some extent.

Mr. F. E. Hill explained that furnace manufacturers wanted to make conditions as easy as possible for the furnace, and did not mind very much about the transformer. It was not possible to reduce the number of tappings. If the L.P. voltage could be raised a little it should be considered, because it cut down the current of the transformer, which was desirable. In connection with rating he had one specification of a furnace transformer for about 2,000 K.V.A., 25 cycles. They specified a temperature on full load of 45 deg. C., a temperature rise of 50 per cent., and overload continuously at 55 deg. C., which would have made the iron loss about 4.6 times the copper losses. Mr. Thompson had only dealt with transformers up to 25,000 volts, but he might have given some consideration to higher voltages. The curves showing K.V.A. ratings against price and weight referred to "nominal

K.V.A. ratings," which was a very misleading term. The author meant the actual K.V.A., but it would be fairer to call it the rated K.V.A. Furnace transformers, even with equivalent K.V.A., were very much more expensive than power transformers.

Mr. Binns said that failure, when it occurred, was invariably attributed to bad design or careless workmanship on the part of the transformer makers. Sheffield steel manufacturers were very prone to this fault. In some cases the electric furnace had been discarded after several breakdowns due to mishandling, where, if there had been a proper appreciation of the apparatus, it would not have suffered the setbacks which resulted from the testimony of those who failed in its use due to ignorance. He would increase the author's figures referring to locations and operation; a minimum distance when stated as satisfactory by the manufacturers tended to become the maximum when space was being allocated by the user. He could not agree that the core type transformer must of necessity suffer from the defects mentioned by the author, or that the shell type suffered from the disadvantages given as hereditary defects; it was all a question of design. To get out a design which might be quite satisfactory for one class of work and then put it forward as the best for all purposes was wrong. Assuming a 3-phase furnace was to be installed, it was generally better to install a 3-phase transformer; this became all the more necessary as the size increased. For a large furnace (8,000 K.V.A. or upwards) the use of single-phase shell type (incidentally the use of 3-phase shell type was not a practical proposition for this purpose) would increase the difficulties of the installation owing to induction in the leads, to such an extent that they became impracticable also. On the other hand, where single-phase transformers were required, as in single and 2-phase furnaces, the circular shell type had definite advantages. Put briefly, it was not a case of core *v.* shell type, but of a design to suit the particular case, which generally would be obtained in the circular shell with the coil faces vertical and the axis horizontal for single-phase work and in the 3-phase core type, again with the coil faces vertical for 3-phase furnaces. The two largest steel furnaces at present in service in this country were each of 15 tons capacity, using two 1,500-K.V.A. single-phase transformers Scott connected. The furnaces were identical except for periodicity of circuit. No tappings were used in the main transformers except the Scott tappings. The voltage variation in 20-volt steps, from 100 volts to 200 volts, was obtained by use of an auto regulating transformer. Voltage regulation, to which the author gave considerable attention, required very careful consideration. Tappings in the main transformers were to be avoided wherever possible. The three largest carbide furnaces in this country were of the 3-phase type, and were each equipped with 3-phase core-type transformers. As far as possible increase in size of steel furnaces was concerned, the author had not mentioned the use of two arcs in series, by which means the voltage could be raised to about 200 volts. The 15-ton furnaces mentioned were of this type, designed by Mr. Victor Stobie. This method made possible the use of furnaces up to approximately 60 tons with the electrodes at present available. So far as carbide furnaces were concerned, the largest built on the Continent was about 25,000 K.V.A., or roughly three times the capacity of the largest in use here. The author's ideal for a furnace transformer was good, although, except in extreme cases, it was not necessary to introduce the complication of an external reactance.

Mr. G. F. Sills thought that furnace manufacturers in the past had been optimistic about what the current was doing; they had claimed a steady current. It was essential that the transformer should be sound mechanically. He deprecated the use of springs in transformers to hold the main connections together. Furnace transformers should be rated at their maximum continuous capacity, *i.e.*, at which the temperature rise of the oil would go up to its maximum. However, trouble was more likely with the oil than with an ordinary transformer where the load came on at different periods of the day and fluctuated.

Mr. Sonner complained that the paper contained nothing about the efficiency of any of the transformers. He thought that an external reactance would be more desirable, and that the reactance in the transformer should be kept as low as possible on account of the relation between efficiency and cost; the efficiency of the transformer was solely a matter of cost.

Mr. J. L. Thompson, in reply, said he was sorry the question of the core *v.* shell type had been brought up again. He did not mention it in the paper in order not to bring forward any criticism of the two types. He referred to horizontal furnace transformers because it showed a new departure. The core being a laminated structure it would give the rigidity derived from being supported by stanchions. His experience had been mainly on the shell type of transformer. With regard to the losses due to the half turn suggested in the paper, there was bound to be a little extra loss on that half turn on account of its close proximity to the iron core. The reactance due to that small increase could be kept within limits by arranging the positive and negative links of the respective coils in parallel. He was in agreement that the rating of the transformer should be more definite so that they might compare transformers of different manufacture throughout the country and of Continental manufacture also.

WIRELESS DIRECTION FINDING.

By Capt. H. J. ROUND.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

(*Concluded from page* 187.)

When Zeppelins were well at sea, night errors were not usually serious, but aeroplanes nearly always gave trouble. It must be remembered that the aeroplane, being small and having the aerial flying out backwards, does not usually radiate a wave in which the electrical lines are predominantly vertical and the magnetic lines horizontal. If this vertically polarised radiation only were present, a receiving loop at a distance would receive no signals when its plane was at right angles to the direction of the aeroplane. If, however, the aeroplane is at a height and some of the magnetic field of the wave reaches the loop in such a manner that it is partly vertical in one plane and with the lines leaning forward towards the receiver in the other plane (fig. 7), a current will be induced in the loop, and the resultant zero position, if the frame is rotated, will be produced by the sum of the two currents due to this effect and that of the vertically polarised wave. The error produced becomes negative instead of positive if the aeroplane reverses its direction. A horizontal loop will receive from an aeroplane flying at a height, on account of this twisted field. An aeroplane flying towards or away from a station gives no error. All the above were daylight results, but it was suggested by Eckersley that this aeroplane effect was produced at night by the reflection from irregularities in the Heaviside layer, and there is good evidence that this theory is true. Again, a horizontal loop receives during night variations, and Eckersley has proved experimentally that the strength on the horizontal loop and the night variation agree with the theory in a remarkable way.

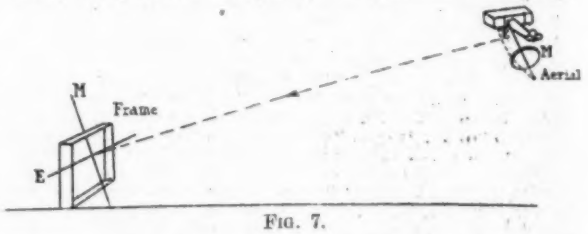


Fig. 7.

Daylight errors, aside from instrumental ones, were much more difficult to notice. They were seldom as much as the possible errors of the instruments. Apparently it is a bad thing to place stations on the edge of high cliffs, near high trees, or near a wood. One station on the edge of a cliff had an error of an apparently complete rotation through 3 degs. By increasing the distance of the station from the cliff edge from $\frac{1}{4}\lambda$ to 2λ the error was completely removed.

Refraction over a coast line undoubtedly exists, and Eckersley has obtained a fairly accurate estimate of the refractive index of the coasts of Palestine and Cyprus, this being checked by a large number of stations. The presence of hills on one side of a station, even some miles away, tends to give bad daylight minima in that direction.

Fig. 8 (*a*) and (*b*).

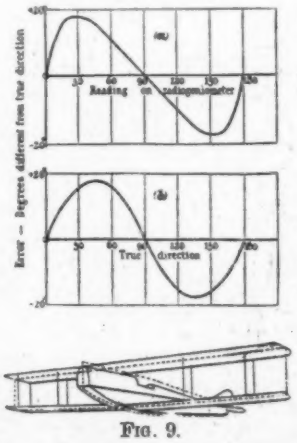


Fig. 9.

In connection with daylight errors G. M. Wright has been very accurately investigating the more minute instrumental errors which occur, and the probability is that new stations to be erected in the future will much more definitely locate errors of site, daylight variation, and deflections from the normal.

The extent to which direction-finding was trusted by the authorities was really remarkable, and I can instance one case

where a most important event in the history of the British Navy was brought about by an observed motion of less than 1½ degrees in the daytime. With so many possible errors at night, one gained a false confidence in the beautiful intersections made by using only two stations and only had occasional shocks when the German fleet was found to be well inland. I personally preferred four stations, the last one being a check on the other three.

A system of good rapid land-line communication to a centre was very essential, and our Post Office in England and the Army authorities in France did magnificent work in this direction.

Besides these groups of stations, many single stations were erected, particularly for submarine work, and very valuable results were obtained. I very much doubt whether a signal was ever made by a German submarine without our stations recording the position.

One of our difficulties was rapid searching over long ranges of wave-length. The first real solution of the problem on Bellini-Tosi lines was indicated by G. M. Wright in 1915, who suggested that the aerial tuning condensers should be short-circuited and a closer coupling made between the search coil and the aerial inductances. I revived the method for continuous wave work, and it enabled me to obtain a circuit with only one condenser to tune—a particularly necessary condition with continuous waves as the tuning is so fine. Independent heterodyne circuits were troublesome on direction finders because of the unequal action of the heterodyne on the two aerials. Also the addition of the extra heterodyne condenser reduced the simplicity of the one condenser circuit, therefore, self-heterodyne circuits were adopted. In the first trial of this system at a coast station I noticed again very serious errors and bad minima. This turned out to be the "Vertical" in a greatly exaggerated form, the reason being that, as the frame is now untuned, the component representing the directional receptive power of the aerial has been considerably reduced, and the component representing "Vertical" reception is now of a sufficient relative magnitude to affect materially the observed direction. A simple solution was obtained which was suitable for all waves above 1,000 metres, and consisted in earthing the mid-points of the two direction-finder coils. With only slight modifications of apparatus this remained our standard continuous-wave apparatus during the remainder of the war. This was also the basis of the "aperiodic" spark direction-finder when the cascade amplifiers were produced.

Up to 1917 we had used soft tubes; tubes of a harder character we could not use, as we had erected such a high standard of sensitiveness that in transferring to hard valves we should have lost a lot of useful results. However, Lieut. W. J. Picken succeeded in June, 1916, in getting five high-frequency magnifications on 200 metres by tuned circuits with much harder stable tubes, and he obtained extraordinary magnification.

Latour's ideas had produced a moderately aperiodic amplifier, but the magnification was still short of the best soft-valve arrangements, and the wave-length was still too long, especially for Army purposes. A three-valve cascade amplifier, built with fine wire coils of one layer, gave a result as good as the Latour amplifier, but with the addition of more valves a grid potentiometer became necessary to prevent oscillations. The copper inter-valve windings were now replaced by resistance wire wound to exactly the same dimensions, which wire for all ordinary work consisted of No. 48 "Eureka." The set now allowed of the use of six valves plus a rectifier, with practically no adjustments and a flatness of tuning which was almost all that could be desired. The much more difficult range of 100-300 metres required by the Army was then attacked. Messrs. Edison & Swan offered to draw nickel-chrome wire down to 1 mil in thickness. The resistance of this wire for the same length is about 3½ times that of No. 48 "Eureka." This was very satisfactory, and a very good degree of flatness was obtained with the seven valves over the range of wave-length required. The magnification is not so good as the longer wave sets, but it was a very great improvement on anything hitherto produced. Cascade sets with a range of from 30 to 50 metres can easily be produced if such wave-lengths are ever required. A set of 11 valves has been made of approximately equal sensitiveness from 250 to 10,000 metres.

"Aperiodic" amplification was now all that could be desired, a rather heavy consumption of valves and valve current being the only disadvantages. At one group of naval stations a pair of 7 H.P. charging engines were found necessary, and 130 valves were running continuously. Almost at once, quick-search one-condenser aperiodic direction finders came into use for spark waves.

Direction finders for 200 metres, constructed with 11 or 22 valves in cascade, enabled us to watch with ease certain "buzzer" intercommunicating sets, with no more error than on the longer wave sets. In these 22-valve sets, 11 valves were connected with quasi aperiodic transformers, a loose tuned coupling was then inserted, and another 11-valve set added. In addition, usually one or two low-frequency amplifiers were added at the end. I measured the total high-frequency magnification at about 500,000. High-frequency amplifiers were used for two reasons. First, a self-heterodyning cascade amplifier is, for some not obvious reason, much less subject to microphonic noises than is a single valve; and secondly, the amount of continuous-wave current produced in the aerial by the self-heterodyne is very considerably less in the case of a cascade amplifier than in the case of a single valve. This enables stations quite close to one another to search over overlapping ranges of wave-length without howling at one another.

I cannot say too much for the high standard of all the operators with whom I came into contact. The keenness of the men really made a doubtful art successful. Some of the men showed very great interest in the growth of the subject technically, and many valuable suggestions came from them. Two in particular made for me all the original cascade amplifiers. One general feeling amongst the Naval Intelligence operators is to meet the one operator who controlled the German Zeppelins and warships. They always imagined he was one particular man who was a super-operator. On several occasions with nine or ten Zeppelins in a raid, all frantically trying to communicate with home for bearings or otherwise, wireless occasionally got into a horrible tangle. At that moment the super-man would arrive, take control, and in a twinkling all would be peace and order.

With regard to atmospherics, during daytime, on one or two occasions, the positions of thunderstorms were approximately determined and checked, but this was not often possible. At night time, particularly in spring and autumn, X's exhibited very frequently—in fact most of the time in England—a sharp direction which varied a little round the position of 165 deg. E. of N. The minimum is often extremely sharp, exactly like a well-defined station. It was suggested that this direction was curiously near the magnetic meridian. We were able to use this direction of X's for interception purposes, as it was fortunately almost at right angles to the direction of the Heligoland Bight. Signals on a vertical aerial, absolutely inaudible owing to X's, were clear without X's in a frame roughly placed at 75 deg. E. of N.

Quite early in the war several ships of His Majesty's Navy were fitted with direction-finding apparatus. Commander Dorling, of H.M.S. *Warspite*, succeeded in obtaining an error curve (fig. 8*a*). The crowding of all the readings towards the 0 deg. and 180 deg. directions, *i.e.*, fore and aft, was very troublesome for taking readings, and we modified the Bellini-Tosi system to correct these errors, which amounted in other cases to as much as 30 deg.

Only since the Armistice have I had an opportunity of trying direction finders on aeroplanes. The four-engine Handley-Page, which went to Newfoundland, was fitted with an extemporised Bellini-Tosi, using an aerial system exactly as on board ship. One aerial was lengthwise round the wings, and the other lengthwise round the fuselage (fig. 9). A correction which was made on the ground was found to hold good when the plane was in the air. An eight-valve long-wave amplifier set gave very satisfactory signals. Magneto noises which were extremely bad were overcome by shielding the magneto leads and, what was more important still, by shielding the complete receiver system with the exception of the aerials. When the engines were running all out, almost complete silence could be obtained. This set was used effectively in the flight from St. John's to the United States, during which flight directions were taken on Clifden. Similar machines have been fitted since, and the same satisfactory results obtained.

I believe the chief use made of the corrected Bellini-Tosi system for ships was in convoy work, but previously the Tenth Cruiser Squadron and other ships had used it during cruising. All this later work on ships was done with Wright's inductive loop or "aperiodic" aerial, and Wright has during the last year developed an extremely small and practical ship direction-finder for use with this type of corrected frame. It is intended to apply the necessary corrections on every ship, with periodical examinations of the corrections when the ship is in port, exactly as a ship's compass is treated.

One advantage a warship has over most merchantmen is that there is fitted a gyro compass with repeater compasses, one of which can be near the direction-finder. If no gyro compass is fitted, the exact direction of the ship is extremely difficult to get simultaneously with the reading taken on the radiogoniometer, especially if the ship is turning or yawing. A useful addition to a ship's direction-finder would be a magnetic compass repeater.

Fig. 8*a*, which is approximately the original error curve of the *Warspite*, was obtained on a Bellini-Tosi system consisting of two frames each placed at 45 deg. to the fore and aft line of the ship. In the first form the shape of the curve was rather puzzling, because the error was plotted against the readings. On replotting the errors against the true directions (fig. 8*b*), the curve became a sine curve.

The Irish Peat Industry.—It has been calculated that the peat fuel supply available in Ireland is equal to about 2,000,000,000 tons of coal. One of the drawbacks to the industry—apart from the several inherent ones—is the fact that the peats must be cut by spade, one at a time, which is slow and laborious work. Recently attempts have been made to invent peat-cutting machines, which would greatly speed up production and lessen cost and bring the industry within the limits of profitable commerce. It is understood that these attempts have taken tangible form, and that at least one peat-cutting machine is now in operation.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Scientific Management.

I was much interested in reading the discussion on Capt. Scott Maxwell's paper to note the remarks of a late employer of mine, who complained of lack of humanity in scientific management.

All I can say is that after being on a variety of jobs in this country and Canada, I never came across a place where less humanity was displayed by the management than in the factory for which this gentleman is responsible.

It makes me sick to see men like this trying to obstruct a system which would give the workman who wants to really work a square deal.

Humanity is the one thing above all others that Taylor stood for. He believed in what Edison calls "human engineering," and he did not believe in the "lump of labour" idea which seems to be taken as true by employers and employés alike in this country.

There is a right job for every man, and it is up to the employers to fit the man to the job, and also so to organise industry as to eliminate unemployment.

Scientist.

February 4th, 1920.

The Rate of Exchange.

For weeks past the rate of exchange in New York and Montreal has been moving against us; to-day the pound is worth between 13s. 8d. and 14s. in New York. Such rates mean the continuation of high food prices in this country, as so much of it is imported from "The West," and that does not brighten our outlook.

But in Great Britain it ought to bring considerable possibilities within the grasp of the manufacturer for the expansion of his trade and for getting a secure foothold in a market which may have been hitherto closed to him. British prices quoted in dollars and cents in the United States and Canada should compare very favourably with prices for similar goods manufactured over there.

It is only a reiteration of the present day war cry of "Production" to say the more we can sell on an adverse exchange the sooner will we return to normal conditions.

M. B. Macdonald.

Edinburgh,
February 6th, 1920.

Petrol and Electricity.

With reference to your statement in the leaderette "Petrol and Electricity" that the cost of energy for propelling a railless trolley-car is about 1¼d. per mile, may I point out that this is on an average road with an average drawbar pull of 60 lb. per ton.

On flat steel tracks (such as should have been laid in our streets any time since 1894) this would fall to 10-12 lb. per ton and the cost to ¼d. They would also be available for every vehicle.

Abolish tramways, relegate horses to by-ways and agricultural districts, and make roads that are imperative for successful motor traction and the (so called) "Traffic Problem" disappears.

Ernest G. Pink.

Ashford, Kent, *February 5th*, 1920.

University Training.

Once again in your "Situations vacant" columns appears a "class bar" advert. It states, "must have university degree or equivalent." So much for democracy in the U.K. The advertisement in question relates to a position as laboratory assistant in connection with high-tension magneto testing, practical experience on magnetos essential. Why then these bars, these obstacles to the ambitious manual worker? It would appear that the advertiser is class prejudiced, or is no student of psychology. Having had practical workshop experience, combined with technical study, either from Polytechnic institutes, or correspondence schools, practical experiments in model making, years of close application to a study of mathematics, physics, &c.; given a natural talent for scientific investigation and ability, either inherent or acquired, to draft plans and originate new devices, may not a "hand" aspire to become a "head"? A man may be penalised by lack of a classical education, according to such stipulations, and all his careful preparations for advancement may be nullified. If England is going to hold any place among the leading industrial nations she must encourage those who have acquired qualities and character to fit them for a vocation. The successful business man of to-day and the future must be a psycho-analyst; one able to put aside notions of birth and biased opinions as to the benefits derived from employing university graduates. Swank and bluff go a long way in some instances in the U.S.A., but there, more attention is paid to a scientific selection of applicants, and if the employé shows ability, he can climb to higher positions, but here—Oh ——!

G. W. Roffe.

London, N.W.
February 7th, 1920.

[Whilst sympathising with our correspondent, we must demur to his conclusions on several grounds. First, he gratuitously assumes that the demand for a "university degree or equivalent" is a "class bar," and undemocratic; this idea is very much out of date. Scientific training is indispensable to the efficiency of the skilled technical electrician in such a position as the one in question, and it will be noted that it need not involve training at a university—the "equivalent" can be obtained at a technical college, as our correspondent himself suggests. Secondly, the advertisement contains no reference to a "classical education"; has he never heard of the degree of Bachelor of Science? Thirdly, Mr. Roffe compares this country with the United States, where, as a matter of fact, the college training is vastly more generally acquired and recognised than it is here. One of the great lessons of the war was that we must follow the examples of the United States and Germany in employing technically trained men in our works. Here, as there, the highest posts in the engineering profession are open to men from the ranks, and it would be easy for us to cite several instances of such advancement. We recommend our correspondent to read the advertisement again with more care and discernment, and to forward his application for the post at once.—EDS. ELEC. REV.]

Projector Lamps.

A friend has been inquiring of me about a high-efficiency incandescent lamp that has been recommended to him for use in a projector lantern, giving about 2,000 C.P., the filament being no more than ½ in. long and suitable for the voltage usual in the larger South American towns. If any of your readers have ever come across such a lamp will they kindly furnish me with details of it and the name of the manufacturer. The ordinary half-watt lamp of that candle power for 220 volts is too large to get into the lantern, and, of course, with such a length of filament much of the light would be wasted. I have suggested the use of a "Pointolite" lamp, of which you gave details not long ago, but we are intent on learning more about the other lamp.

Norwich, *February 9th*, 1920.

William Roe.

Electrolytic Meters.

With regard to Mr. C. W. Marshall's article on cheap house service meters, the statement that electrolytic meters "are not used to any great extent" is rather sweeping, considering that two prominent makers of that type of meter cannot cope with present orders. As your correspondent rightly states, a cheap meter is wanted, but I am of the opinion that 5 amperes is rather a large size, seeing that the maximum lighting demand of the average house does not exceed 2 amperes, and is likely to be less when the half-watt lamp is further developed. A 5-ampere meter demands heavier moving parts and consequently more friction, thus making it difficult to bring in the lower loads, to say nothing of increasing the cost.

I think that however much the cost of a motor meter may be reduced it will never be able to compete in price with the electrolytic meter, and if the disadvantages of refilling and resetting in the latter type can be successfully overcome, there is no doubt that the electrolytic meter will have a sale equal to, if not greater than, that of the motor type, always assuming that the price is right.

H. W. M.

February 9th, 1920.

With reference to the article on "Cheap House Service Meters" by Mr. C. W. Marshall, appearing in the ELECTRICAL REVIEW of the 6th inst., it would give the impression to readers that the use of the electrolytic meter for direct current is on the decrease. As far as we are aware this is not the case; our experience is just the reverse, and points to the fact that the use of electrolytic meters—of our make at any rate—is very much on the increase.

The extreme accuracy of the Bastian meter, together with its simplicity and low price, all tend to this end, and is a great inducement to engineers to continue the use of meters for registration, rather than resort to a system of charging which does not involve the use of meters at all for small consumers; and in fact a very great number are supplied by us specially for installing in small houses.

The Bastian Meter Co., Ltd.
ALBERT E. SALISBURY, *Managing Director.*

London, N.W., *February 10th*, 1920.

ELECTRICAL IMPORTS AND EXPORTS OF JAPAN.

The following statement shows the import and export trade of Japan in 1918 in electrical and similar goods. For purposes of comparison, figures for 1917 have been added, together with a note of increases or decreases.

IMPORTS.

Country whence imported	1917 Yen	1918 Yen	Inc. or dec. Yen
Posts and materials for electric lines.—			
United States	9,000	16,000	+ 7,000
Insulated electric wire.—			
United States	47,000	70,000	+ 23,000
Steam turbines.—			
United States	164,000	275,000	+ 111,000
Gas Engines, petroleum engines, and hot-air engines.—			
United Kingdom	29,000	—	- 29,000
Germany	1,000	—	- 1,000
Sweden	48,000	15,000	- 33,000
United States	180,000	480,000	+ 300,000
Asiatic Russia	4,000	5,000	+ 1,000
Kwantung Province	—	5,000	+ 5,000
Other countries	1,000	—	- 1,000
Total	263,000	505,000	+ 242,000
Steam engines.—			
United Kingdom	205,000	22,000	- 183,000
United States	88,000	416,000	+ 328,000
Kwantung Province	—	13,000	+ 13,000
France	42,000	—	- 42,000
Germany	42,000	3,000	- 39,000
Total	399,000	463,000	+ 64,000
Steam boilers and parts.—			
China	100,000	—	- 100,000
Kwantung Province	29,000	116,000	+ 87,000
Asiatic Russia	6,000	1,000	- 5,000
Philippine Islands	—	2,000	+ 2,000
United Kingdom	1,090,000	1,285,000	+ 195,000
Norway	—	19,000	+ 19,000
Russia	—	50,000	+ 50,000
United States	1,377,000	6,015,000	+4,638,000
Other countries	110,000	47,000	- 63,000
Total	2,712,000	7,535,000	+4,823,000
Dynamos, motors, transformers, &c.—			
Kwantung Province	—	17,000	+ 17,000
United Kingdom	49,000	38,000	- 11,000
Germany	2,000	—	- 2,000
United States	1,077,000	2,976,000	+1,899,000
Other countries	2,000	30,000	+ 28,000
Total	1,130,000	3,061,000	+1,931,000
Telegraphic and telephonic instruments and parts.—			
United Kingdom	7,000	1,000	- 6,000
France	1,000	1,000	—
Denmark	3,000	14,000	+ 11,000
United States	50,000	75,000	+ 25,000
Total	61,000	91,000	+ 30,000
Water turbines and Pelton wheels.—			
United Kingdom	23,000	—	- 23,000
France	—	13,000	+ 13,000
Switzerland	133,000	32,000	- 101,000
Sweden	136,000	4,000	- 132,000
United States	14,000	33,000	+ 19,000
Total	306,000	82,000	- 224,000
Incandescent electric lamps.—			
United Kingdom	2,000	4,000	+ 2,000
United States	12,000	39,000	+ 27,000
Other countries	1,000	1,000	—
Total	15,000	44,000	+ 29,000
Watt meters.—			
United Kingdom	42,000	23,000	- 19,000
Switzerland	252,000	201,000	- 51,000
United States	185,000	236,000	+ 51,000
Other countries	1,000	—	- 1,000
Total	480,000	460,000	- 20,000
Ammeters and voltmeters.—			
United Kingdom	2,000	1,000	- 1,000
Switzerland	1,000	—	- 1,000
United States	164,000	217,000	+ 53,000
Total	167,000	218,000	+ 51,000
Accumulators.—			
United Kingdom	21,000	—	- 21,000
Germany	—	4,000	+ 4,000
United States	15,000	22,000	+ 7,000
Total	36,000	26,000	- 10,000
Filaments for incandescent lamps.—			
United Kingdom	118,000	107,000	- 11,000
France	33,000	7,000	- 26,000
Switzerland	1,000	—	- 1,000
Sweden	23,000	3,000	- 20,000
United States	240,000	202,000	- 38,000
Total	416,000	320,000	- 96,000
Carbon for electric use.—			
United Kingdom	13,000	20,000	+ 7,000
France	—	3,000	+ 3,000
United States	210,000	251,000	+ 41,000
Other countries	3,000	1,000	- 2,000
Total	226,000	275,000	+ 49,000

EXPORTS.

Country to which exported	1917 Yen	1918 Yen	Inc. or dec. Yen
Electrical machinery and parts thereof.—			
China	698,000	1,005,000	+ 307,000
Kwantung Province	757,000	1,513,000	+ 756,000
Hong Kong	42,000	62,000	+ 20,000
British India	330,000	207,000	- 123,000
British S.S.	27,000	53,000	+ 26,000
Dutch India	46,000	275,000	+ 229,000
French Indo-China	1,000	11,000	+ 10,000
Asiatic Russia	241,000	13,000	- 228,000
Philippine Islands	20,000	34,000	+ 14,000
Siam	5,000	16,000	+ 11,000
United Kingdom	84,000	33,000	- 51,000
France	—	245,000	+ 245,000
Italy	9,000	—	- 9,000
Switzerland	9,000	—	- 9,000
United States	8,000	2,000	- 6,000
Canada	12,000	10,000	- 2,000
Chili	2,000	20,000	+ 18,000
Argentine	—	20,000	+ 20,000
Egypt	—	28,000	+ 28,000
Cape Colony and Natal	39,000	83,000	+ 44,000
Australia	148,000	296,000	+ 148,000
New Zealand	12,000	53,000	+ 41,000
Other countries	3,000	5,000	+ 2,000
Total	2,493,000	3,984,000	+1,491,000
Telephones and parts thereof.—			
China	203,000	182,000	- 21,000
Kwantung Province	67,000	172,000	+ 105,000
Hong Kong	—	4,000	+ 4,000
British India	3,000	4,000	+ 1,000
Dutch India	1,000	42,000	+ 41,000
Asiatic Russia	131,000	12,000	- 119,000
Philippine Islands	—	1,000	+ 1,000
Russia	22,000	—	- 22,000
United States	1,000	—	- 1,000
New Zealand	—	1,000	+ 1,000
Other countries	2,000	3,000	+ 1,000
Total	430,000	421,000	- 9,000
Electric insulated wire.—			
China	1,129,000	1,312,000	+ 183,000
Kwantung Province	566,000	622,000	+ 56,000
Hong Kong	139,000	173,000	+ 34,000
British India	464,000	1,349,000	+ 885,000
British S.S.	45,000	119,000	+ 74,000
Dutch India	165,000	1,025,000	+ 860,000
French Indo-China	17,000	40,000	+ 23,000
Asiatic Russia	159,000	70,000	- 89,000
Philippine Islands	—	44,000	+ 44,000
Siam	60,000	44,000	- 16,000
Other Asiatic countries	2,000	—	- 2,000
United Kingdom	4,000	63,000	+ 59,000
France	—	10,000	+ 10,000
United States	—	7,000	+ 7,000
Peru	—	13,000	+ 13,000
Chili	10,000	86,000	+ 76,000
Argentine	8,000	305,000	+ 297,000
Egypt	—	107,000	+ 107,000
Cape Colony and Natal	78,000	214,000	+ 136,000
Australia	169,000	2,485,000	+2,316,000
New Zealand	103,000	231,000	+ 128,000
Other countries	1,000	5,000	+ 4,000
Total	3,119,000	8,324,000	+5,205,000

Yen = 2s. 0½d.

	1917	1918	Inc. or dec.
Electric lamps.—	Yen	Yen	Yen
China	376,000	482,000	+ 106,000
Kwantung Province ...	167,000	242,000	+ 75,000
Hong Kong	69,000	157,000	+ 88,000
British India	239,000	267,000	+ 22,000
British S.S.	16,000	25,000	+ 9,000
Dutch India	56,000	108,000	+ 52,000
French Indo-China ...	13,000	31,000	+ 18,000
Asiatic Russia	1,243,000	37,000	−1,206,000
Siam	9,000	51,000	+ 42,000
United Kingdom	33,000	143,000	+ 110,000
France	6,000	135,000	+ 129,000
Italy	—	61,000	+ 61,000
United States	230,000	53,000	− 177,000
Canada	296,000	239,000	− 57,000
Other North American countries	—	5,000	+ 5,000
Peru	2,000	18,000	+ 16,000
Chile	2,000	15,000	+ 13,000
Argentine	2,000	17,000	+ 15,000
Brazil	—	1,000	+ 1,000
Other South American countries	—	3,000	+ 3,000
Egypt	4,000	55,000	+ 51,000
Cape Colony and Natal ...	3,000	28,000	+ 25,000
Other African countries ...	4,000	—	− 4,000
Australia	71,000	379,000	+ 308,000
New Zealand	1,000	11,000	+ 10,000
Hawaii	—	3,000	+ 3,000
Philippine Islands ...	5,000	7,000	+ 2,000
Other countries	—	3,000	+ 3,000
Total	2,847,000	2,570,000	− 277,000

NEW PATENTS APPLIED FOR 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

2,346. "Mechanical ignition device for petrol, &c., engines." M. Lingbevington. January 26th.

2,348. "Electrically-heated irons." V. Summerhayes. January 26th.

2,354. "Electric switch of the tumbler type." S. E. Foster. January 26th.

2,356. "Electric relays for protective and operating gear." A. E. Moore. January 26th.

2,372. "Electrical resistance furnaces." H. Etchells and H. A. Greaves. January 26th.

2,378. "Electrically-heated irons." H. Cheshire and Cranmer & Cheshire. January 26th.

2,382. "Directive radio-telegraph or telephone receiving systems." F. J. Chambers. January 26th.

2,383. "Means for rendering electric light switches, lampholders, &c., visible in dark." W. Emmerson. January 26th.

2,398. "Sparking plugs." H. E. Holloway. January 26th.

2,402. "Combined reflector shade and lamp-lock for electric lamps." H. R. Watson. January 26th.

2,424. "Shades for incandescent electric lamps." G. E. Osmond. January 26th.

2,434. "Sparking appliances for ignition of internal-combustion engines." Otto-Werke Ges. January 26th. (Germany, April 27th, 1918.)

2,440. "Telephone switchboards." S. Fisher. January 26th.

2,445. "Magneto starters." J. F. Adye. January 26th.

2,461. "Electric pocket lamps." E. Blondy. January 27th. (France, February 20th, 1919.)

2,465. "Obtaining multiphase currents." A. M. Taylor. January 27th.

2,472. "Process for manufacture of electric incandescent lamps." S. O. Cowper-Coles. January 27th.

2,482. "Machine to obtain continuous currents without commutator, &c." J. E. Salthouse. January 27th.

2,504. "Protective arrangement for electric distribution systems." J. R. Beard and Electrical Improvements, Ltd. January 27th.

2,518. "Ignition of internal-combustion engines." E. Lanzerotti-Spina, and Thomas Transmission, Ltd., and K. J. Thomson. January 27th.

2,521. "Electrical heater." D. Lyon. January 27th.

2,525. "Magnet coils." Siemens-Schuckertwerke. January 27th. (Germany, October 19th, 1918.)

2,528. "Electric foot and food warmer." L. A. Edwards. January 27th.

2,542. "Protective devices." British Thomson-Houston Co. (General Electric Co., U.S.A.) January 27th.

2,592. "Commutating assembling devices." Toledo Standard Commutator Co. January 27th. (United States, March 3rd, 1917.)

2,608. "Electric lamp fitted with shade or reflector." C. West. January 28th.

2,635. "Shield for sparking plugs." J. E. Barrows. January 28th.

2,636. "Incandescent electric lamps." Crowther & Osborn, H. J. Osborn, and W. J. Pattison. January 28th.

2,655. "Electric burglar-detainer." F. W. Wassell. January 28th.

2,657. "Suspension of electrodes in electric furnaces." Norske Aktieselskab for Elektrokemisk Industri Norsk Industri-Hypotekbank. January 28th. (Norway, January 28th, 1919.)

2,666. "Fittings for holding incandescent electric lamps, &c." W. H. Bayley, G. A. Taylor and J. T. Taylor. January 28th.

2,687. "Wireless telegraphy and telephony." E. Hoghton and Portholme Aircraft Co. January 28th.

2,689. "Electric resistances." British Thomson-Houston Co. (General Electric Co., U.S.A.) January 28th.

2,703. "Continuous electrical mechanical filter." A. F. Meston. January 28th.

2,710. "Electro-deposition of metals on iron and alloys of iron." R. J. Fletcher. January 28th.

2,712. "Magneto-electric ignition apparatus for internal-combustion engines." American Bosch Magneto Corporation. January 28th. (United States, April 8th, 1919.)

2,724. "Electric switches." Igranic Electric Co. (Cutler-Hammer Manufacturing Co.) January 28th.

2,726. "Means for securing field magnets of dynamo-electric machines." A. Kettlewell and C. H. Vidal. January 28th.

2,730. "Connecting devices for electrical apparatus, &c." A. J. Cattle and C. J. Thornewill. January 28th.

2,740. "Sparking plugs." J. E. Barrows. January 29th.

2,772. "Thief-proof magneto cut-out." B. Goodyear. January 29th.

2,781. "Speed-control arrangements for dynamo-electric machinery." Siemens-Schuckertwerke. January 29th. (Germany, July 3rd, 1917.)

2,814. "Short-circuiting device for electric ignition apparatus." O. Imray. (Bosch Akt. Ges.) January 29th.

2,815. "Electric starting devices for internal-combustion engines." O. Imray. (Bosch Akt. Ges.) January 29th.

2,816. "Sockets or caps for incandescent electric lamps." H. H. Berry. January 29th.

2,818. "Detachable ceiling fixture for electric pendants, &c." F. T. Cash. January 29th.

2,822. "Electric transformers." F. E. Berry. January 29th.

2,824. "Electro-mechanical attachments for indicating vacant seats in theatres, &c." E. G. Pyne and H. D. Pyne. January 29th.

2,835. "Cleaning, adjusting and testing apparatus for sparking plugs." T. Chalk. January 29th.

2,839. "Electrical resistance control." L. Hulbert. January 29th.

2,848. "Sparking plugs." Gilardoni Fils et Cie. January 29th. (France, October 4th, 1919.)

2,850. "Intercommunication, &c., telephones." W. Stott and Telephone Manufacturing Co. January 29th.

2,858. "Distribution on single-phase and two-phase alternating current systems." A. M. Taylor. January 27th.

2,889. "Frictional electrical machines." J. H. Cowen. January 30th.

2,901. "Conduits, &c." W. P. Thompson (Compagnie Generale de Telegraphie et de Telephonie). January 30th.

2,902. "Excitation of oscillating circuits." R. B. Goldschmidt. January 30th. (Belgium, November 18th, 1913.)

2,919. "Electric switches." G. Comboni. January 30th. (Italy, February 8th, 1919.)

2,943. "Magneto platforms for internal-combustion engines." G. M. L. Griffith and Griffith & Charnock. January 30th.

2,956. "Dynamo-electric machines." British Thomson-Houston Co. and A. A. Pollock. January 30th.

2,957. "Electrical systems of power transmission and regenerative braking." British Thomson-Houston Co. (General Electric Co., U.S.A.). January 30th.

2,971. "Electro-magnetic control arrangements." C. Maier. January 30th. (Switzerland, February 8th, 1919.)

2,983. "Combined electric lamps and condensers for kinematograph projectors." L. Henshaw and J. W. Hinks. January 31st.

3,000. "Transmission by high-frequency currents." L. N. Brillouin. January 31st. (France, January 31st, 1919.)

3,001. "Windings for dynamo-electric machines." J. W. Howard and Siemens Bros. Dynamo Works. January 31st.

3,053. "Recording sound transmitted telephonically." A. F. Sykes. January 31st.

3,068-9. "Wireless transmitters." W. T. Ditcham. January 31st.

3,070. "Insulation of electrical conductors." W. T. Henley's Telegraph Works Co. and M. Roberts. January 31st.

3,073. "Electric switches." L. Trabet. January 31st. (France, September 16th, 1919.)

3,076. "Electric lamps for use in presence of explosive gases." G. M. Meyer. January 31st.

3,077. "Connectors for electrically-heated apparatus." K. W. Johansson. January 31st. (Sweden, February 24th, 1919.)

3,078. "Electrical connectors." K. W. Johansson. January 31st. (Sweden, November 7th, 1919.)

3,081. "Cooling arrangements for electrical machinery." Siemens-Schuckertwerke. January 31st. (Germany, October 7th, 1918.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

21,269. Electric bell or buzzer. C. W. H. Honor. June 4th, 1918. (137,349.)

21,568. Electric lamps or torches. J. Burri. October 8th. (133,682.)

21,653. Automatic temperature control for electric irons. S. L. Goldsbrough. December 24th, 1918. (137,352.)

1919.

694. Telephone circuits. B. S. Cohen. January 9th, 1919. (137,367.)

913. Spark plugs. W. W. Bugh. January 13th, 1919. (137,372.)

1,811. Automatic telephone systems. Automatic Telephone Manufacturing Co. and P. T. Bates. January 24th, 1919. (137,390.)

4,188. Electrical switches. J. H. Thorne. February 20th, 1919. (137,410.)

4,955. Trolley for electric tramways. G. Odierno. February 27th, 1919. (137,417.)

4,990. Electrical push switches for mines or other gaseous places. A. H. Marsh. February 28th, 1919. (137,418.)

6,743. Electric arc-incandescent lamps. A. Garbarini. July 3rd, 1918. (129,259.)

7,148. Electric signalling controlled by mechanical vibrations. J. Gardener. March 22nd, 1919. (137,433.)

7,396. Electric lamps. L. S. Vello. March 23rd, 1918. (124,756.)

7,799. Trolley heads for electric tramcars and other vehicles. H. R. Tidswell and S. K. Kirkland. March 28th, 1919. (137,437.)

8,877. Electric signalling apparatus for cars or electric and other railways. H. Schaub and C. Kunzli. April 23rd, 1919. (125,948.)

14,842. Rotary rectifier of alternating current. A. D. Macropoulos. June 12th, 1919. (137,477.)

17,534. Electric cut-outs. A. H. Railing, C. C. Garrard and W. Wilson. February 20th, 1919. (137,489.)

20,877. Electric lighting apparatus for cycles and motor cycles. C. von der Weid. September 10th, 1918. (132,782.)